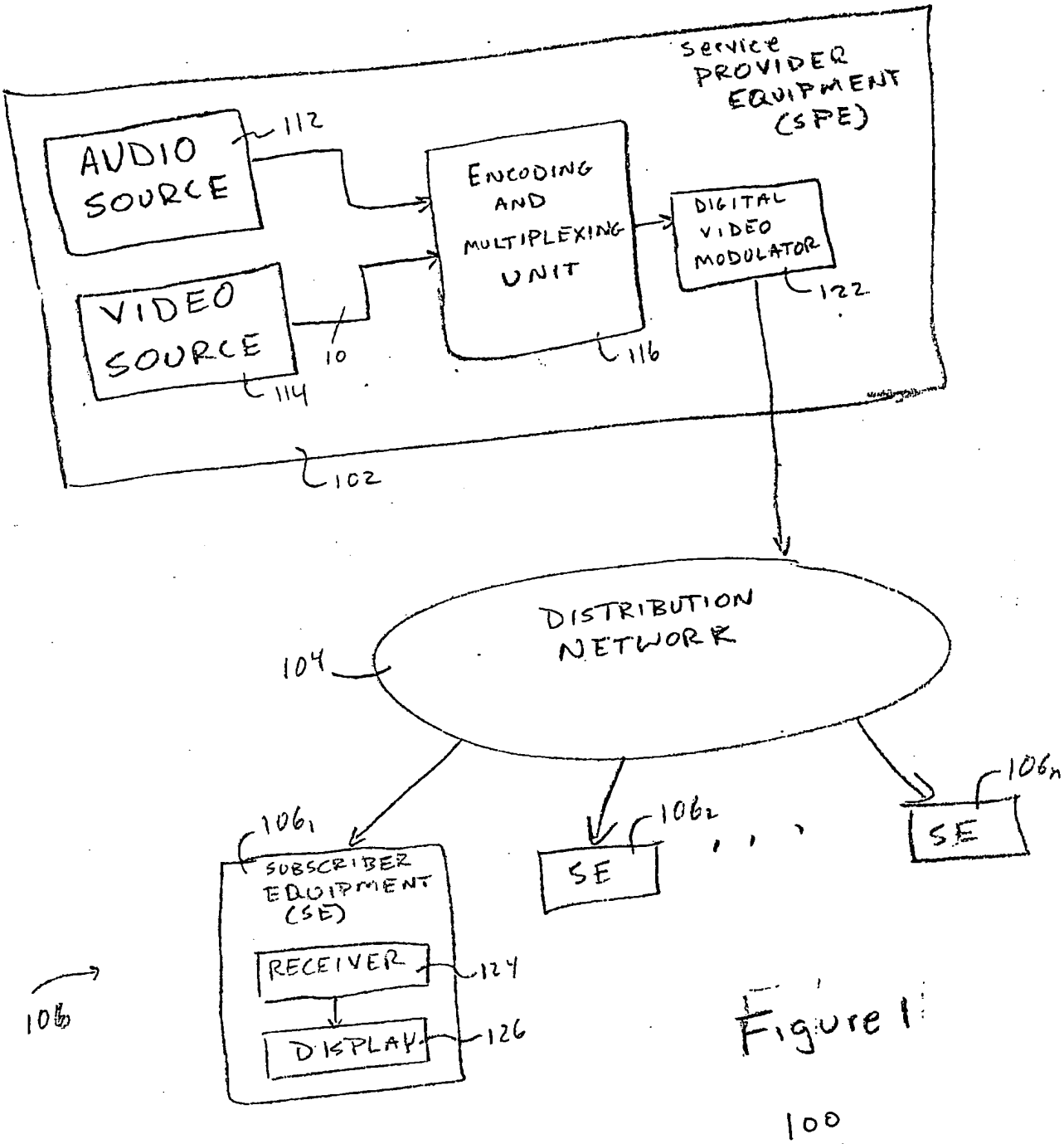
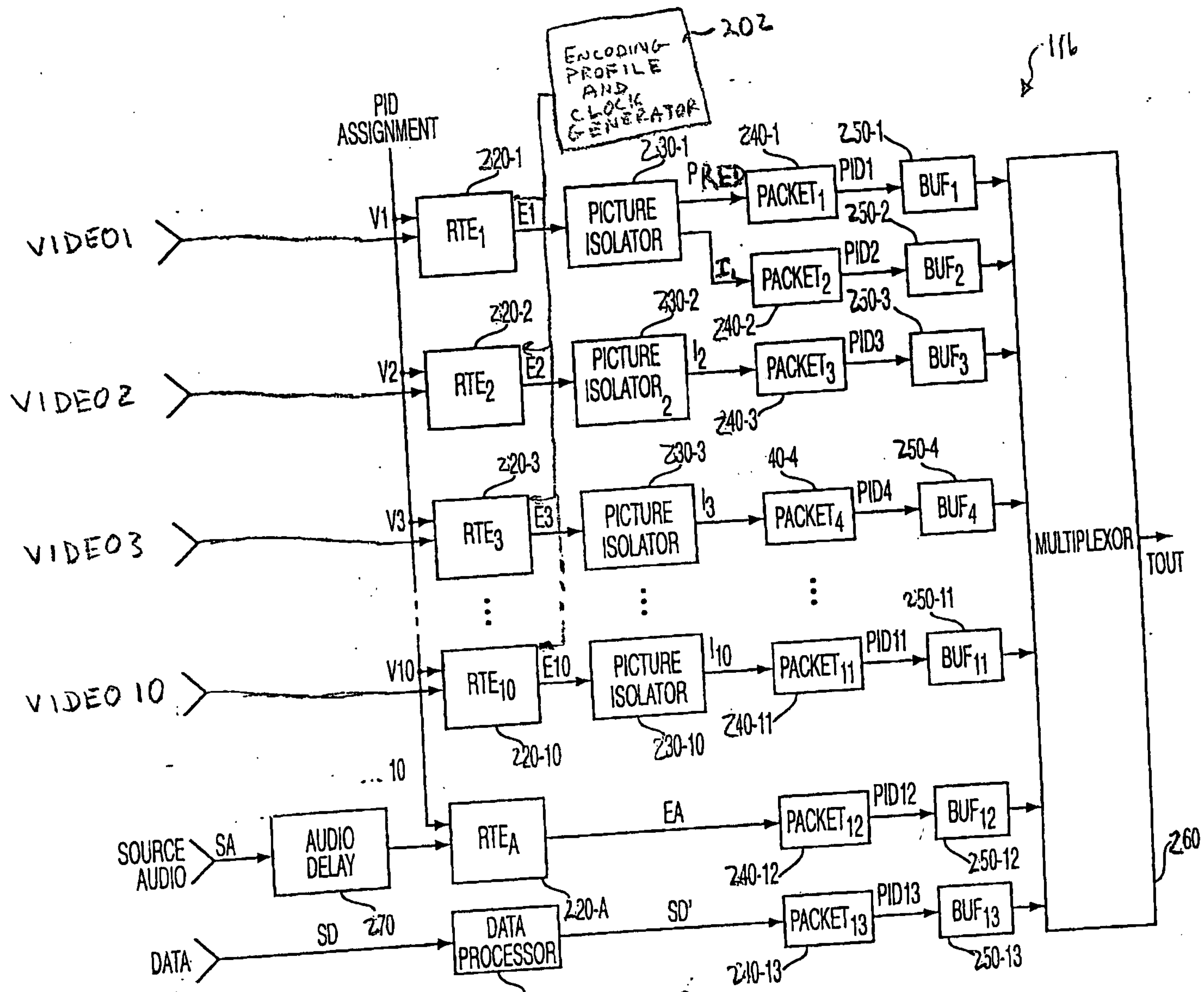

Service PROVIDER EQUIPMENT (SPE)
AUDIO SOURCE
112
VIDEO SOURCE
114
10
ENCODING AND MULTIPLEXING UNIT
116
DIGITAL VIDEO MODULATOR
122
102
DISTRIBUTION NETWORK
104
106_1
SUBSCRIBER EQUIPMENT (SE)
RECEIVER
124
DISPLAY
126
106_2
SE
106_n
SE
106

Figure 1

100



202
ENCODING PROFILE AND CLOCK GENERATOR
116
PID ASSIGNMENT
VIDEO1
VIDEO2
VIDEO3
VIDEO10
V1
V2
V3
V10
220-1
220-2
220-3
220-10
RTE1
RTE2
RTE3
RTE10
E1
E2
E3
E10
230-1
230-2
230-3
230-10
PICTURE ISOLATOR
PICTURE ISOLATOR2
PRED
I1
I2
I3
I10
240-1
240-2
240-3
40-4
240-11
240-12
240-13
PACKET1
PACKET2
PACKET3
PACKET4
PACKET11
PACKET12
PACKET13
PID1
PID2
PID3
PID4
PID11
PID12
PID13
250-1
250-2
250-3
250-4
250-11
250-12
250-13
BUF1
BUF2
BUF3
BUF4
BUF11
BUF12
BUF13
MULTIPLEXOR
TOUT
260
... 10
SOURCE AUDIO
SA
AUDIO DELAY
270
RTEA
220-A
EA
DATA
SD
DATA PROCESSOR
280
SD'

Figure 2

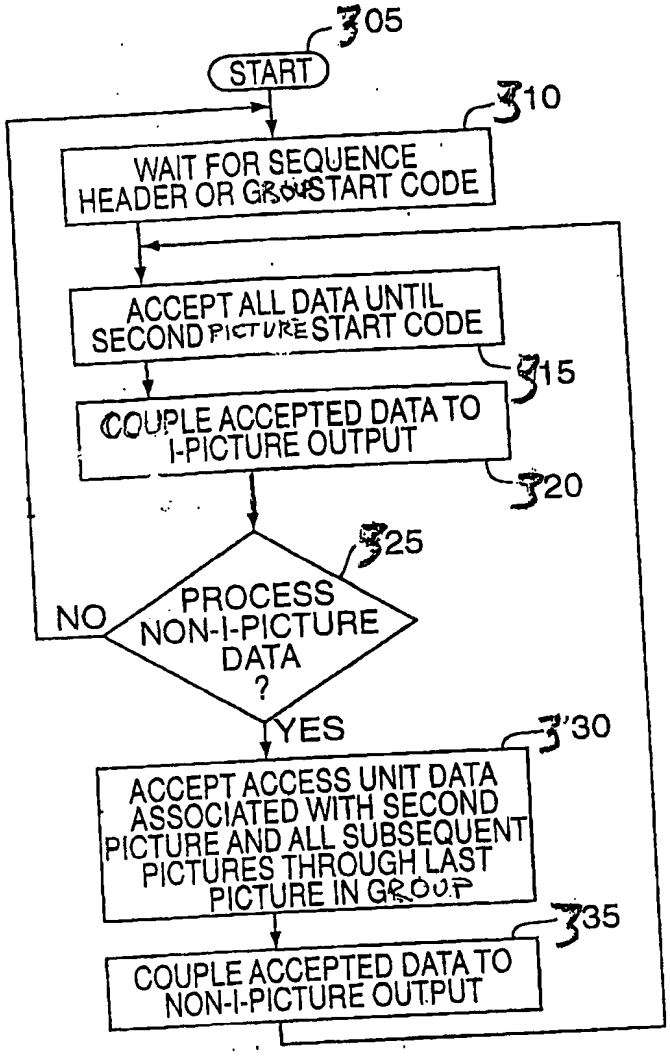

305
START
310
WAIT FOR SEQUENCE HEADER OR GROUP START CODE
ACCEPT ALL DATA UNTIL SECOND PICTURE START CODE
315
COUPLE ACCEPTED DATA TO I-PICTURE OUTPUT
320
325
PROCESS NON-I-PICTURE DATA ?
NO
YES
330
ACCEPT ACCESS UNIT DATA ASSOCIATED WITH SECOND PICTURE AND ALL SUBSEQUENT PICTURES THROUGH LAST PICTURE IN GROUP
335
COUPLE ACCEPTED DATA TO NON-I-PICTURE OUTPUT

Figure 3

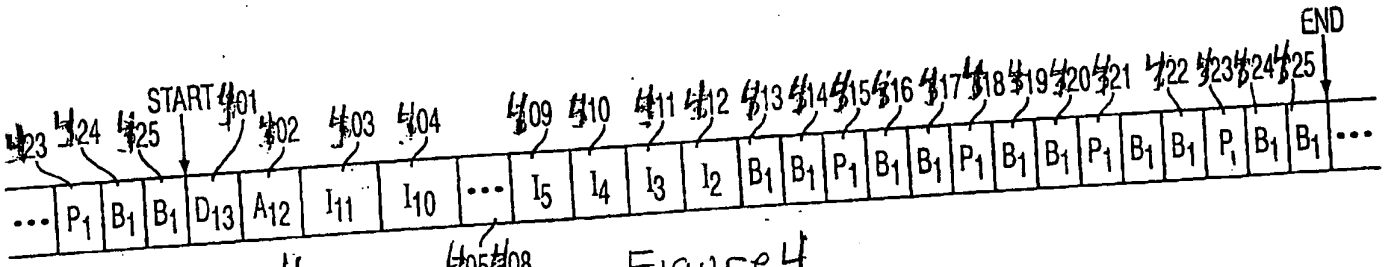

START
END
123 124 125 101 102 103 104 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
... P1 B1 B1 D13 A12 I11 I10 ... I5 I4 I3 I2 B1 B1 P1 B1 B1 P1 B1 B1 P1 B1 B1 P1 B1 B1 ...
100
105 108

Figure 4

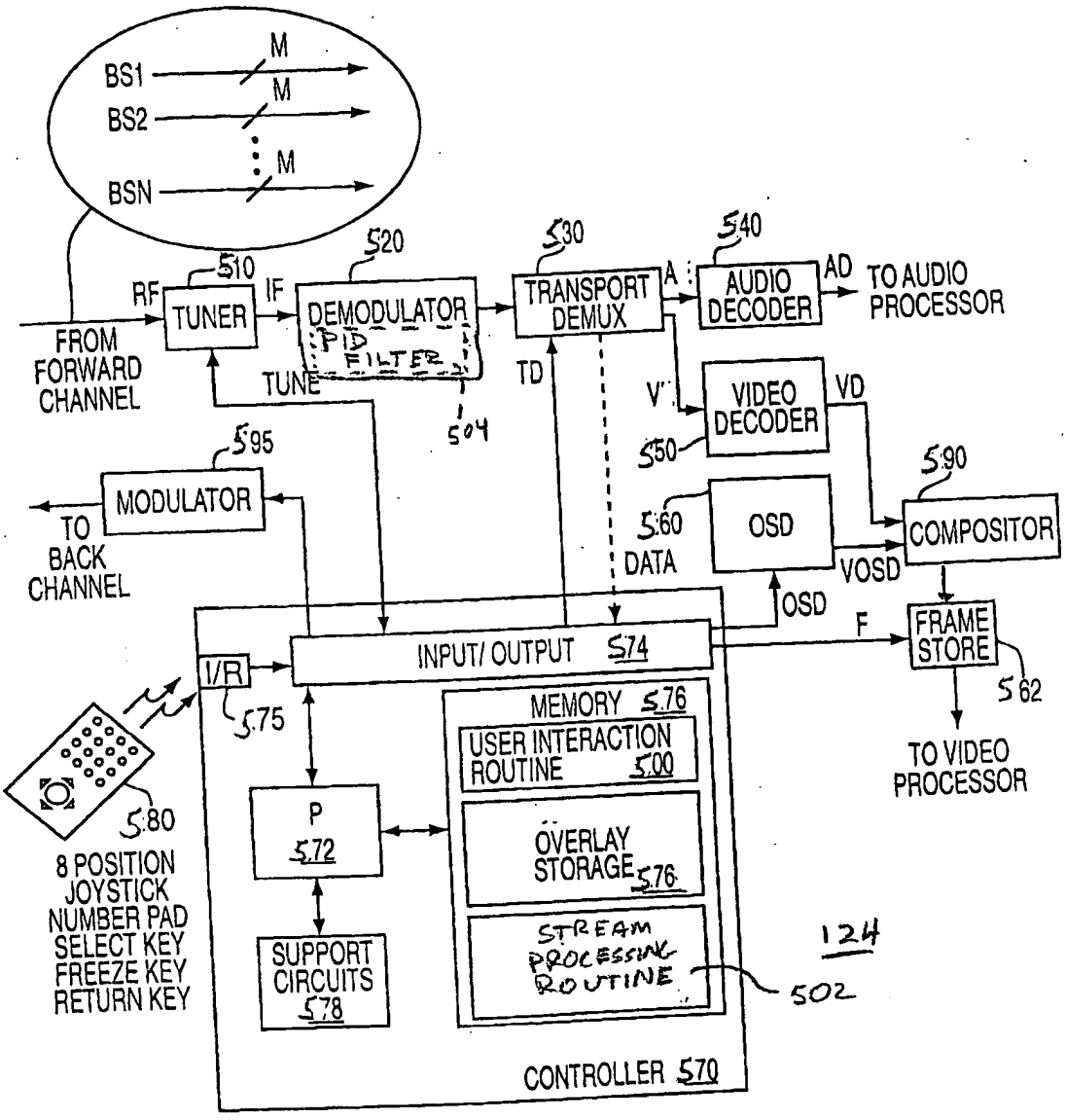

BS1
BS2
BSN
M
M
M
FROM FORWARD CHANNEL
RF
TUNER
510
IF
DEMODULATOR
520
PID FILTER
504
TUNE
TRANSPORT DEMUX
530
TD
A
AUDIO DECODER
540
AD
TO AUDIO PROCESSOR
V
VIDEO DECODER
550
VD
MODULATOR
595
TO BACK CHANNEL
560
DATA
OSD
590
COMPOSITOR
VOSD
OSD
F
FRAME STORE
562
TO VIDEO PROCESSOR
INPUT/ OUTPUT 574
I/R
575
MEMORY 576
USER INTERACTION ROUTINE 500
P 572
OVERLAY STORAGE 576
STREAM PROCESSING ROUTINE
502
124
SUPPORT CIRCUITS 578
580
8 POSITION JOYSTICK
NUMBER PAD
SELECT KEY
FREEZE KEY
RETURN KEY
CONTROLLER 570

Figure 5

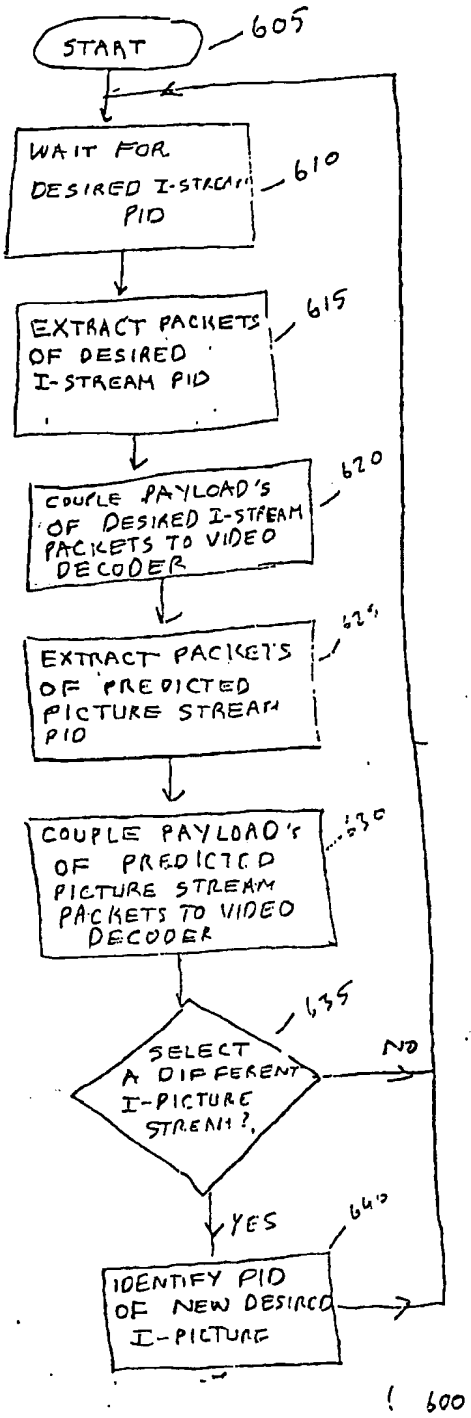

START
605
WAIT FOR DESIRED I-STREAM PID
610
EXTRACT PACKETS OF DESIRED I-STREAM PID
615
COUPLE PAYLOAD'S OF DESIRED I-STREAM PACKETS TO VIDEO DECODER
620
EXTRACT PACKETS OF PREDICTED PICTURE STREAM PID
625
COUPLE PAYLOAD'S OF PREDICTED PICTURE STREAM PACKETS TO VIDEO DECODER
630
SELECT A DIFFERENT I-PICTURE STREAM?
635
NO
YES
640
IDENTIFY PID OF NEW DESIRED I-PICTURE
600

Figure 6

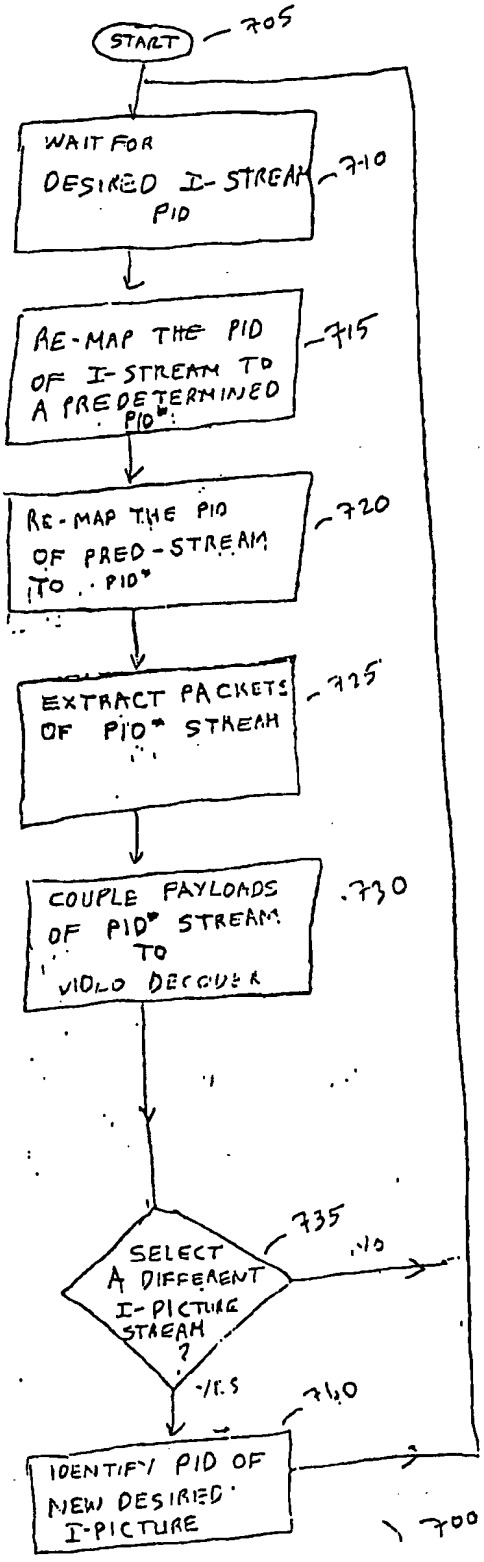

START
705
WAIT FOR DESIRED I-STREAM PID
710
RE-MAP THE PID OF I-STREAM TO A PREDETERMINED PID*
715
RE-MAP THE PID OF PRED-STREAM TO PID*
720
EXTRACT PACKETS OF PID* STREAM
725
COUPLE PAYLOADS OF PID* STREAM TO VIDEO DECODER
730
SELECT A DIFFERENT I-PICTURE STREAM ?
735
NO
YES
740
IDENTIFY PID OF NEW DESIRED I-PICTURE
700

Figure 7

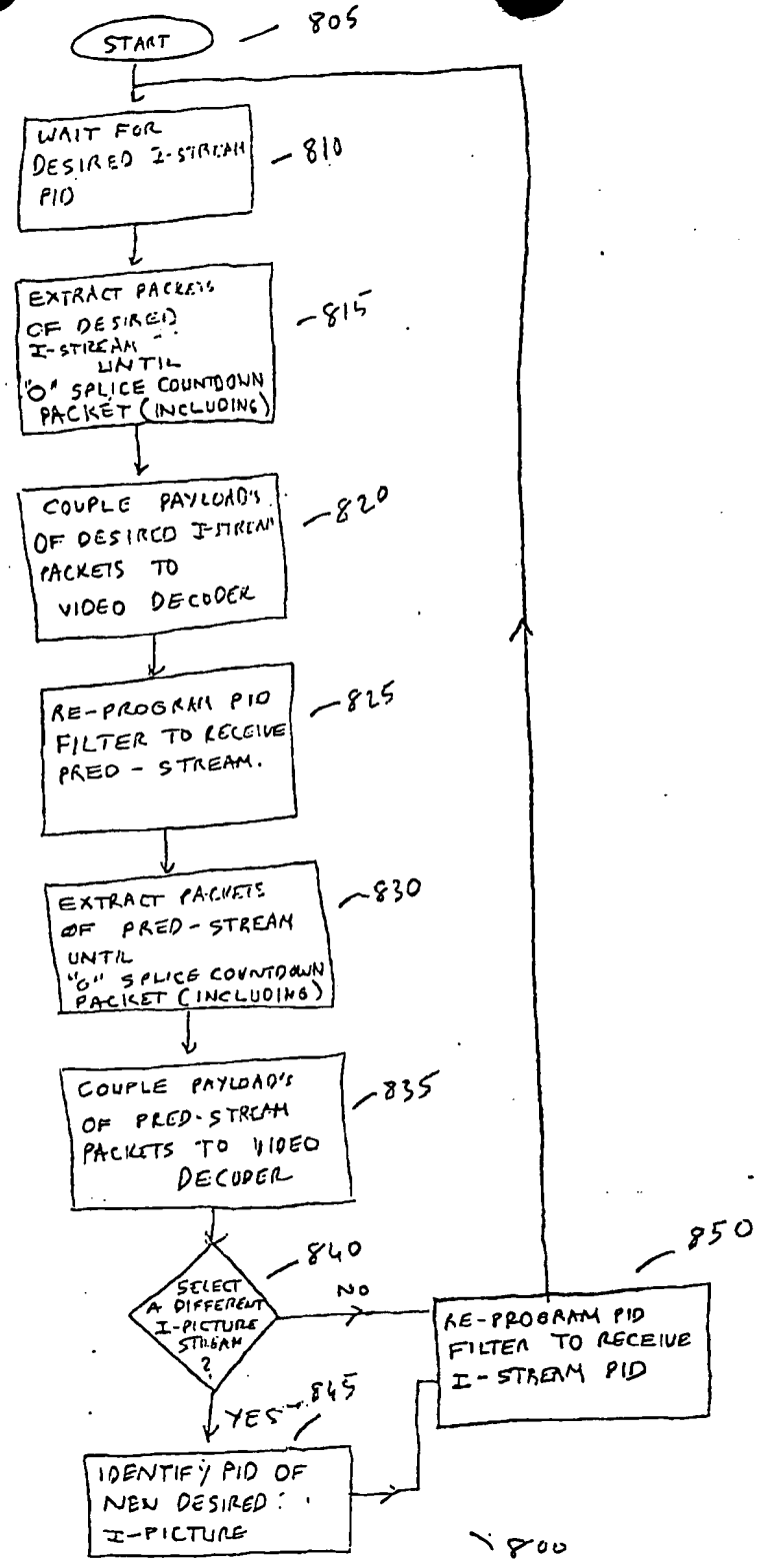

START
805
WAIT FOR DESIRED I-STREAM PID
810
EXTRACT PACKETS OF DESIRED I-STREAM UNTIL "0" SPLICE COUNTDOWN PACKET (INCLUDING)
815
COUPLE PAYLOAD'S OF DESIRED I-STREAM PACKETS TO VIDEO DECODER
820
RE-PROGRAM PID FILTER TO RECEIVE PRED-STREAM.
825
EXTRACT PACKETS OF PRED-STREAM UNTIL "0" SPLICE COUNTDOWN PACKET (INCLUDING)
830
COUPLE PAYLOAD'S OF PRED-STREAM PACKETS TO VIDEO DECODER
835
SELECT A DIFFERENT I-PICTURE STREAM ?
840
NO
YES
845
RE-PROGRAM PID FILTER TO RECEIVE I-STREAM PID
850
IDENTIFY PID OF NEW DESIRED I-PICTURE
800

Figure 8

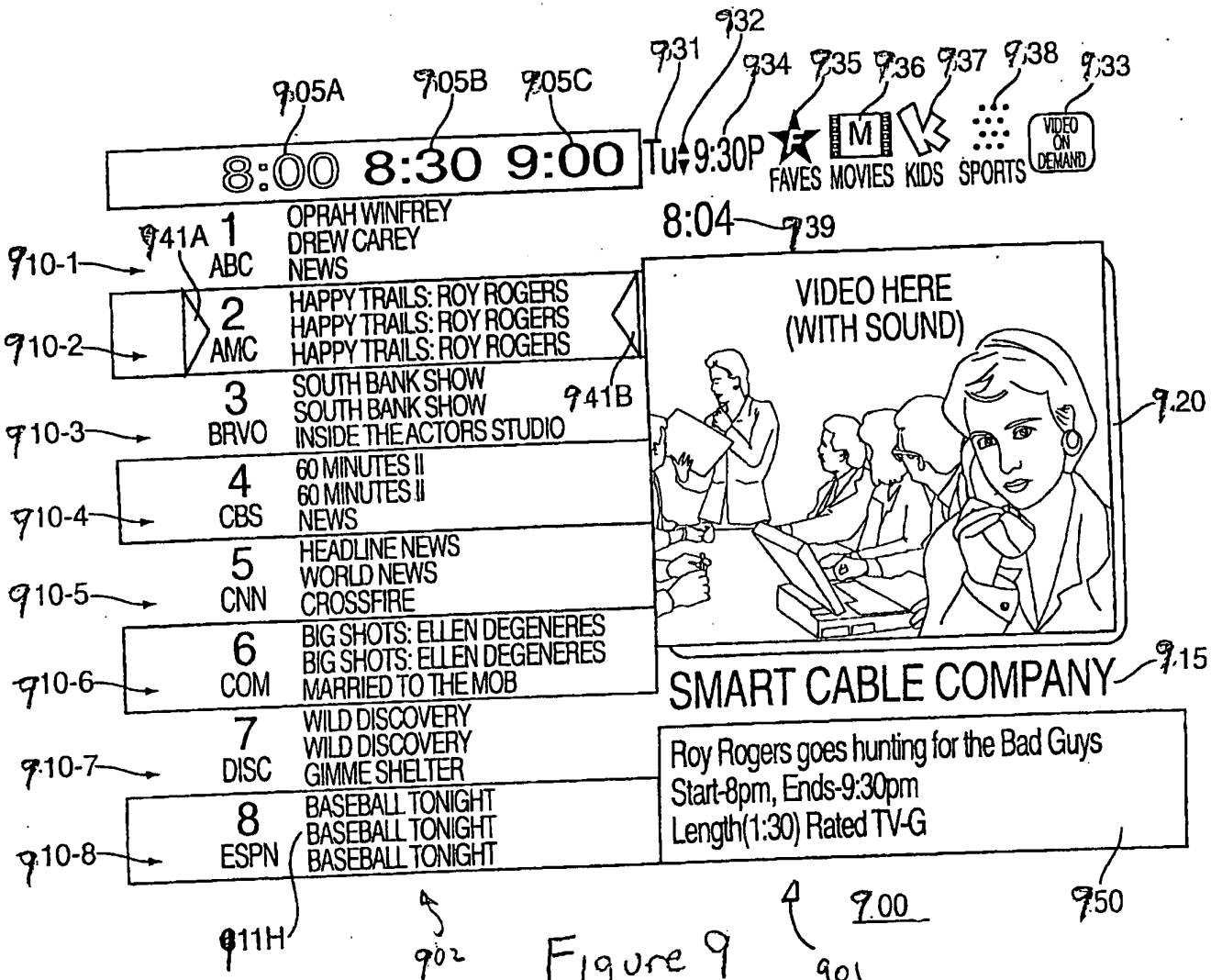

905A
905B
905C
931
932
934
935
936
937
938
933
8:00 8:30 9:00
Tu 9:30P
FAVES
MOVIES
KIDS
SPORTS
VIDEO ON DEMAND
8:04
939
941A
910-1
1 ABC OPRAH WINFREY DREW CAREY NEWS
910-2
2 AMC HAPPY TRAILS: ROY ROGERS HAPPY TRAILS: ROY ROGERS HAPPY TRAILS: ROY ROGERS
941B
910-3
3 BRVO SOUTH BANK SHOW SOUTH BANK SHOW INSIDE THE ACTORS STUDIO
910-4
4 CBS 60 MINUTES II 60 MINUTES II NEWS
910-5
5 CNN HEADLINE NEWS WORLD NEWS CROSSFIRE
910-6
6 COM BIG SHOTS: ELLEN DEGENERES BIG SHOTS: ELLEN DEGENERES MARRIED TO THE MOB
910-7
7 DISC WILD DISCOVERY WILD DISCOVERY GIMME SHELTER
910-8
8 ESPN BASEBALL TONIGHT BASEBALL TONIGHT BASEBALL TONIGHT
911H
902
VIDEO HERE (WITH SOUND)
920
SMART CABLE COMPANY
915
Roy Rogers goes hunting for the Bad Guys
Start-8pm, Ends-9:30pm
Length(1:30) Rated TV-G
950
900
901

Figure 9

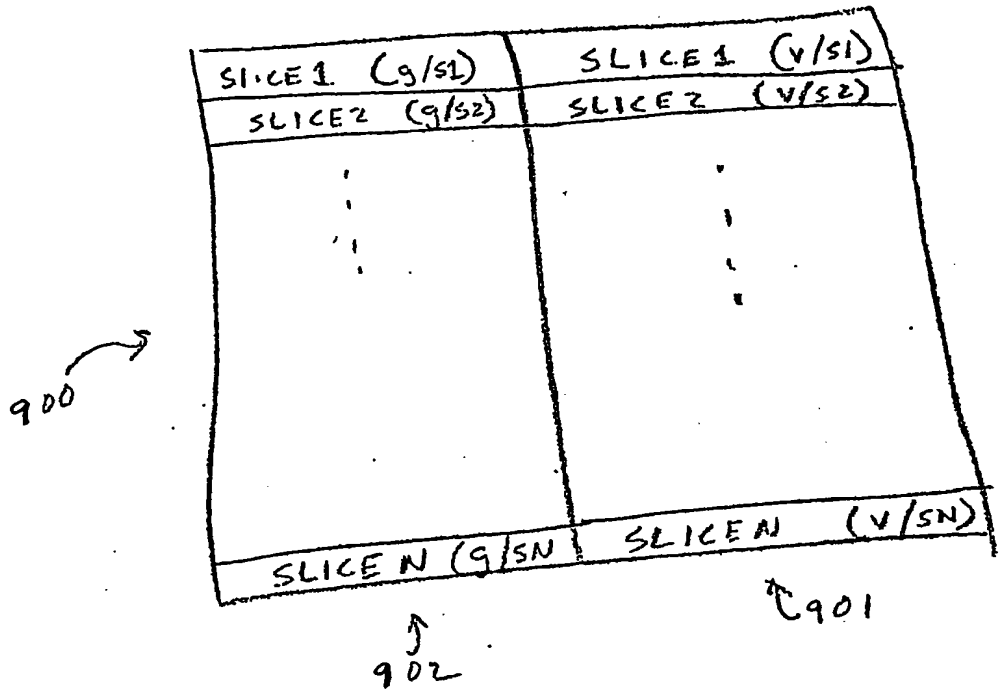

SLICE 1 (G/S1)
SLICE 1 (V/S1)
SLICE 2 (G/S2)
SLICE 2 (V/S2)
SLICE N (G/SN)
SLICE N (V/SN)
900
901
902

FIGURE 9A

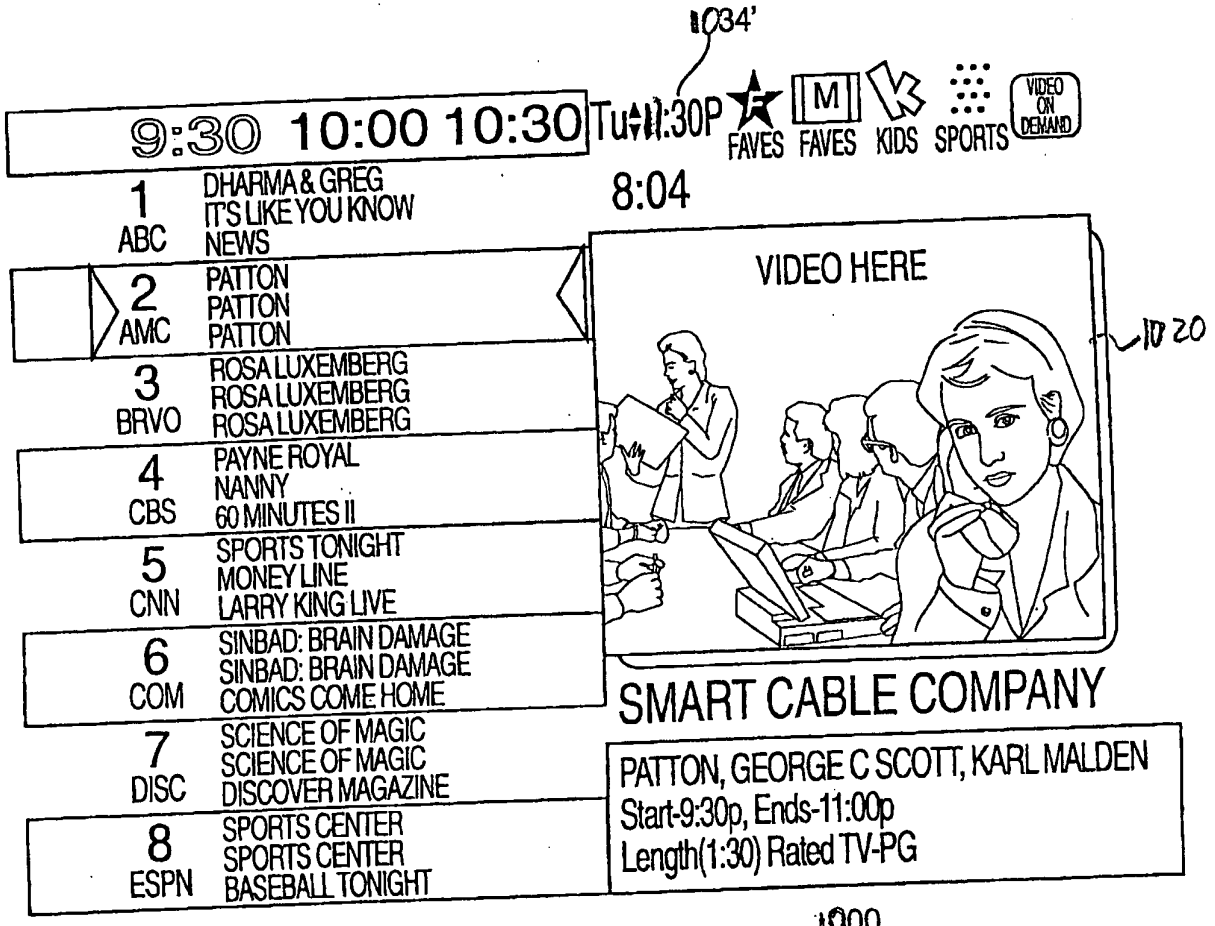

1034'
9:30 10:00 10:30
Tu 11:30P
FAVES
M
FAVES
KIDS
SPORTS
VIDEO ON DEMAND
8:04
1 ABC DHARMA & GREG IT'S LIKE YOU KNOW NEWS
2 AMC PATTON PATTON PATTON
3 BRVO ROSA LUXEMBERG ROSA LUXEMBERG ROSA LUXEMBERG
4 CBS PAYNE ROYAL NANNY 60 MINUTES II
5 CNN SPORTS TONIGHT MONEY LINE LARRY KING LIVE
6 COM SINBAD: BRAIN DAMAGE SINBAD: BRAIN DAMAGE COMICS COME HOME
7 DISC SCIENCE OF MAGIC SCIENCE OF MAGIC DISCOVER MAGAZINE
8 ESPN SPORTS CENTER SPORTS CENTER BASEBALL TONIGHT
VIDEO HERE
1020
SMART CABLE COMPANY
PATTON, GEORGE C SCOTT, KARL MALDEN
Start-9:30p, Ends-11:00p
Length(1:30) Rated TV-PG
1000
1002

Figure 10

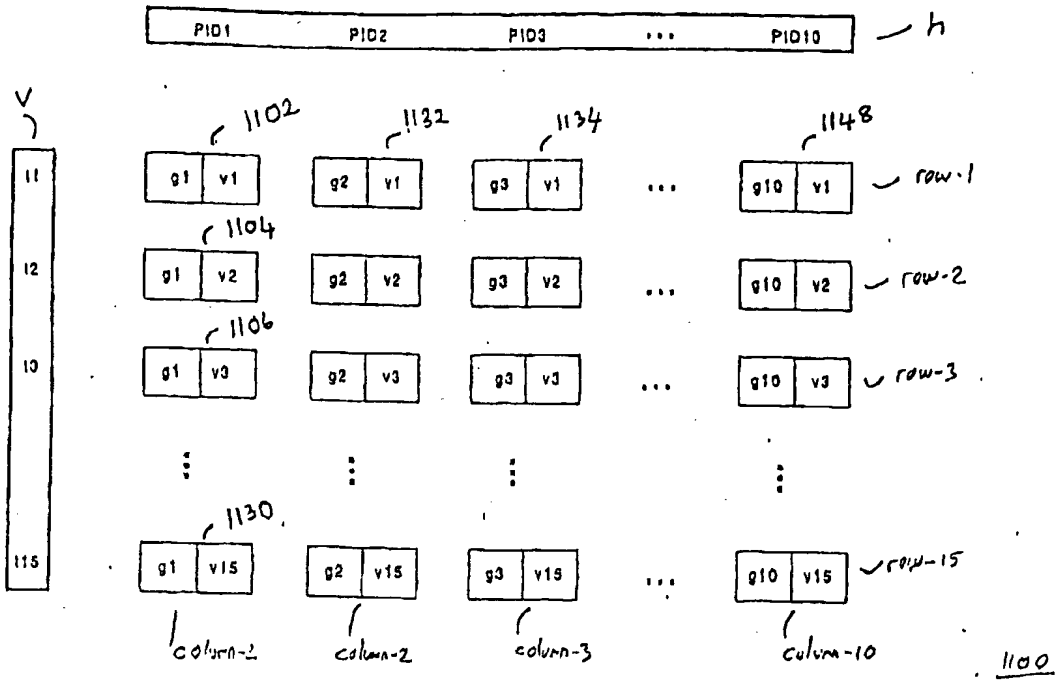

PID1
PID2
PID3
...
PID10
h
V
I1
I2
I10
I15
1102
1132
1134
1148
1104
1106
1130
g1 v1
g2 v1
g3 v1
g10 v1
row-1
g1 v2
g2 v2
g3 v2
g10 v2
row-2
g1 v3
g2 v3
g3 v3
g10 v3
row-3
g1 v15
g2 v15
g3 v15
g10 v15
row-15
column-1
column-2
column-3
column-10
1100

Figure 11

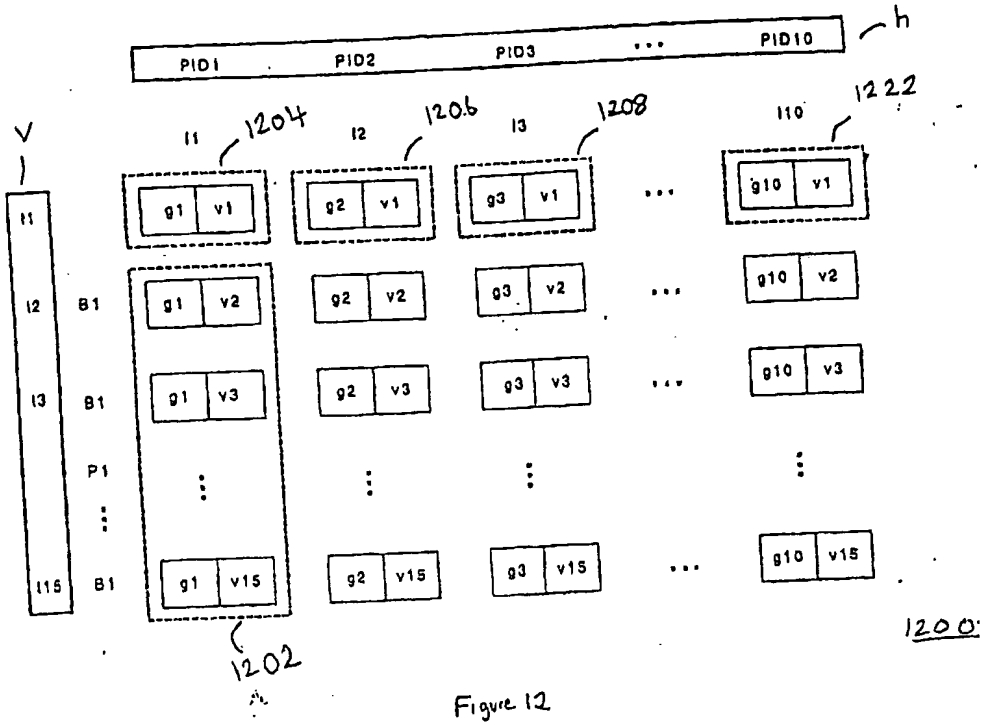

h
PID1
PID2
PID3
...
PID10
V
I1
I2
I3
I10
1204
1206
1208
1222
g1 v1
g2 v1
g3 v1
g10 v1
I2 B1
I3 B1
P1
I15 B1
g1 v2
g2 v2
g3 v2
g10 v2
g1 v3
g2 v3
g3 v3
g10 v3
g1 v15
g2 v15
g3 v15
g10 v15
1202
1200

Figure 12

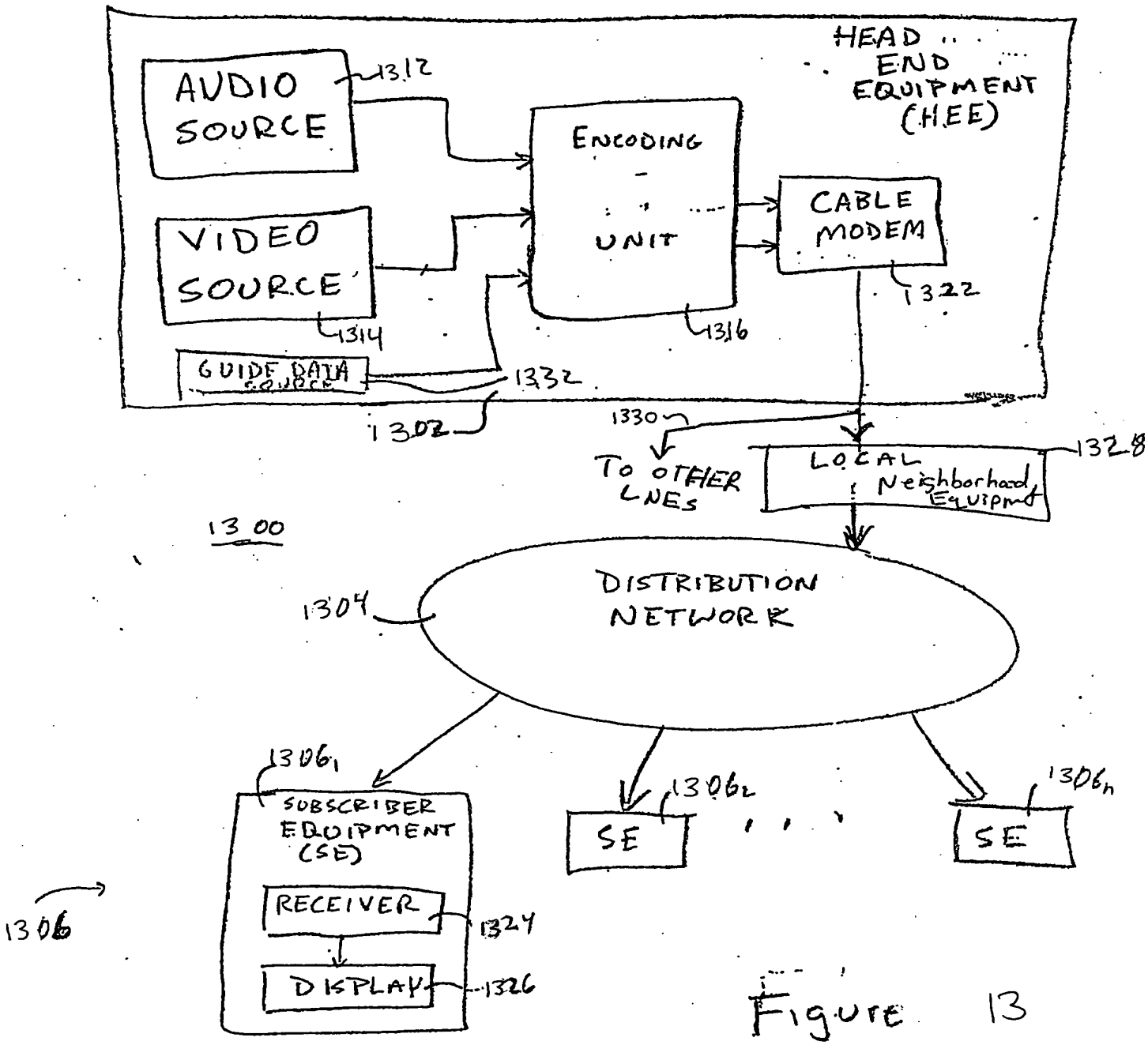

HEAD END EQUIPMENT (HEE)
AUDIO SOURCE
1312
VIDEO SOURCE
1314
GUIDE DATA SOURCE
1332
ENCODING UNIT
1316
CABLE MODEM
1322
1302
1330
TO OTHER LNES
LOCAL Neighborhood Equipmt
1328
1300
DISTRIBUTION NETWORK
1304
1306₁
SUBSCRIBER EQUIPMENT (SE)
RECEIVER
1324
DISPLAY
1326
1306₂
SE
1306n
SE
1306

Figure 13

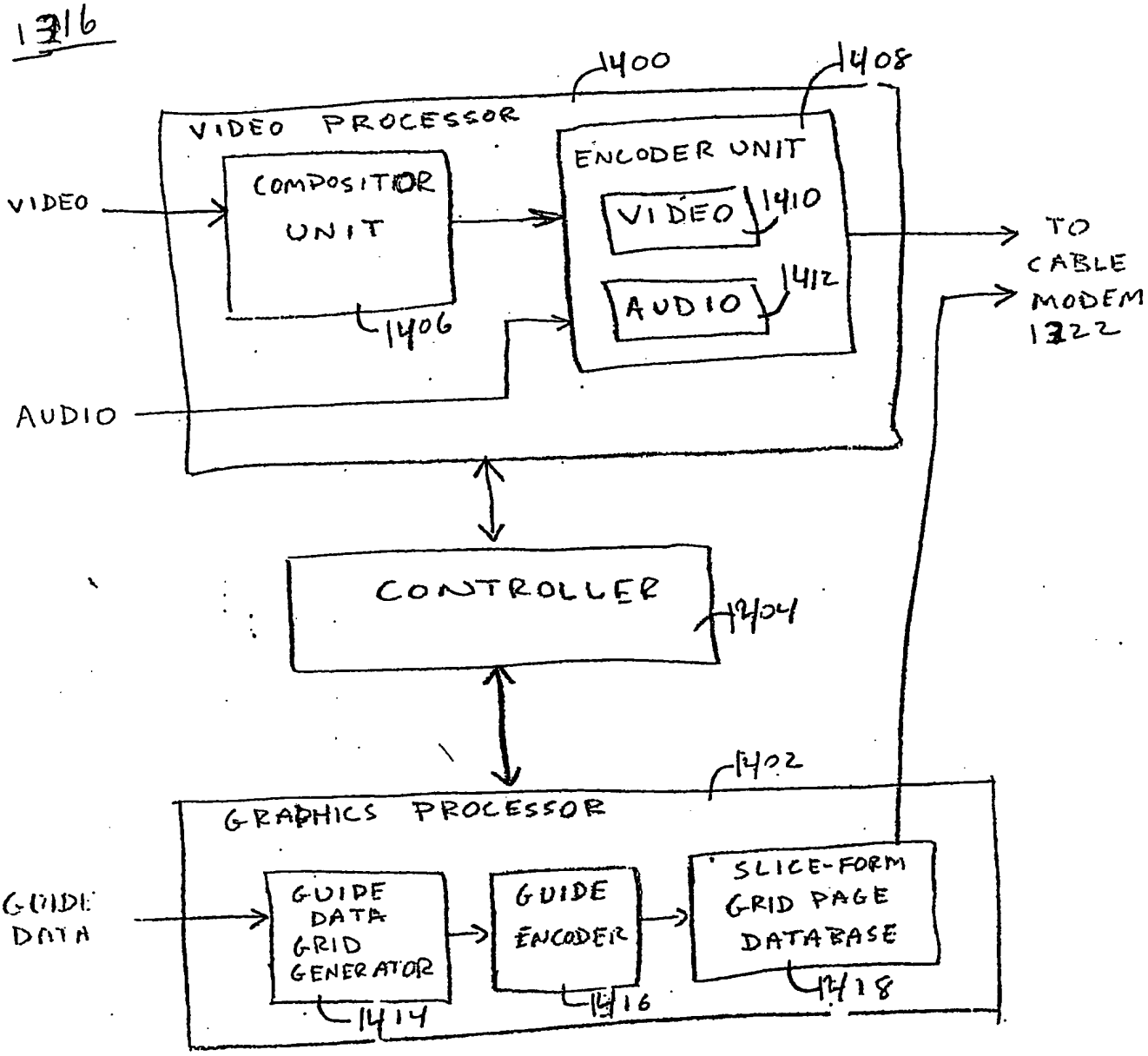

1316
1400
1408
VIDEO PROCESSOR
ENCODER UNIT
VIDEO
COMPOSITOR UNIT
1410
VIDEO
1412
AUDIO
1406
AUDIO
TO CABLE MODEM 1322
CONTROLLER
1404
1402
GRAPHICS PROCESSOR
GUIDE DATA
GUIDE DATA GRID GENERATOR
GUIDE ENCODER
SLICE-FORM GRID PAGE DATABASE
1414
1416
1418

FIGURE 14

1328

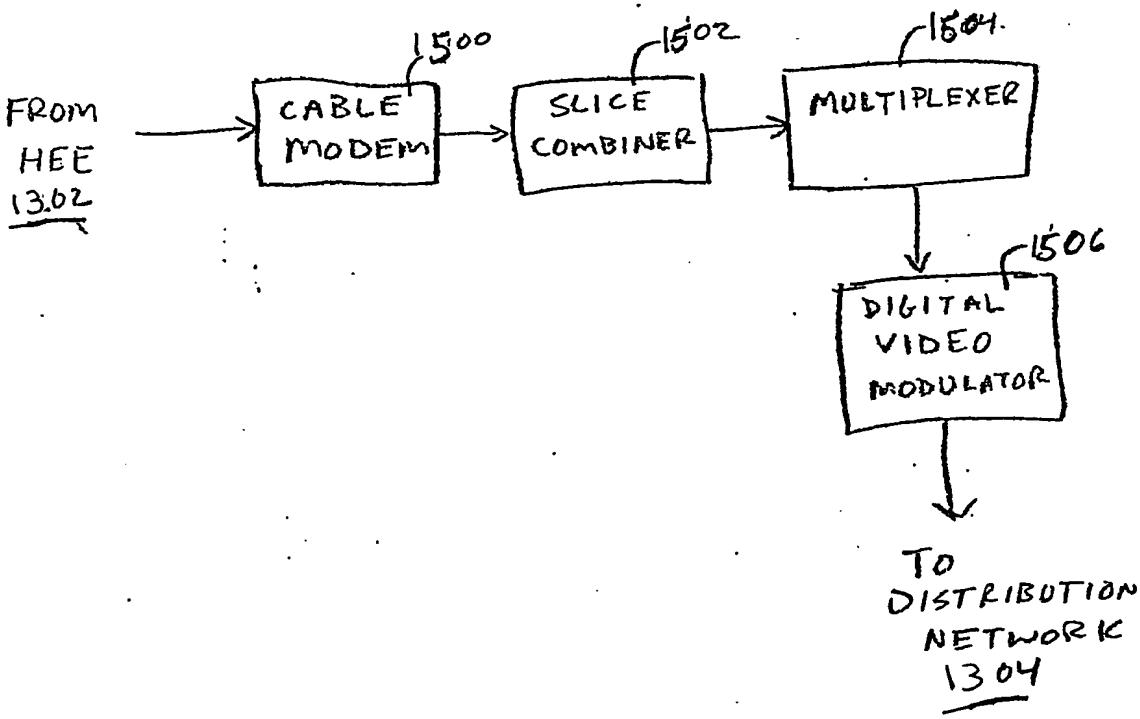


FIGURE 15

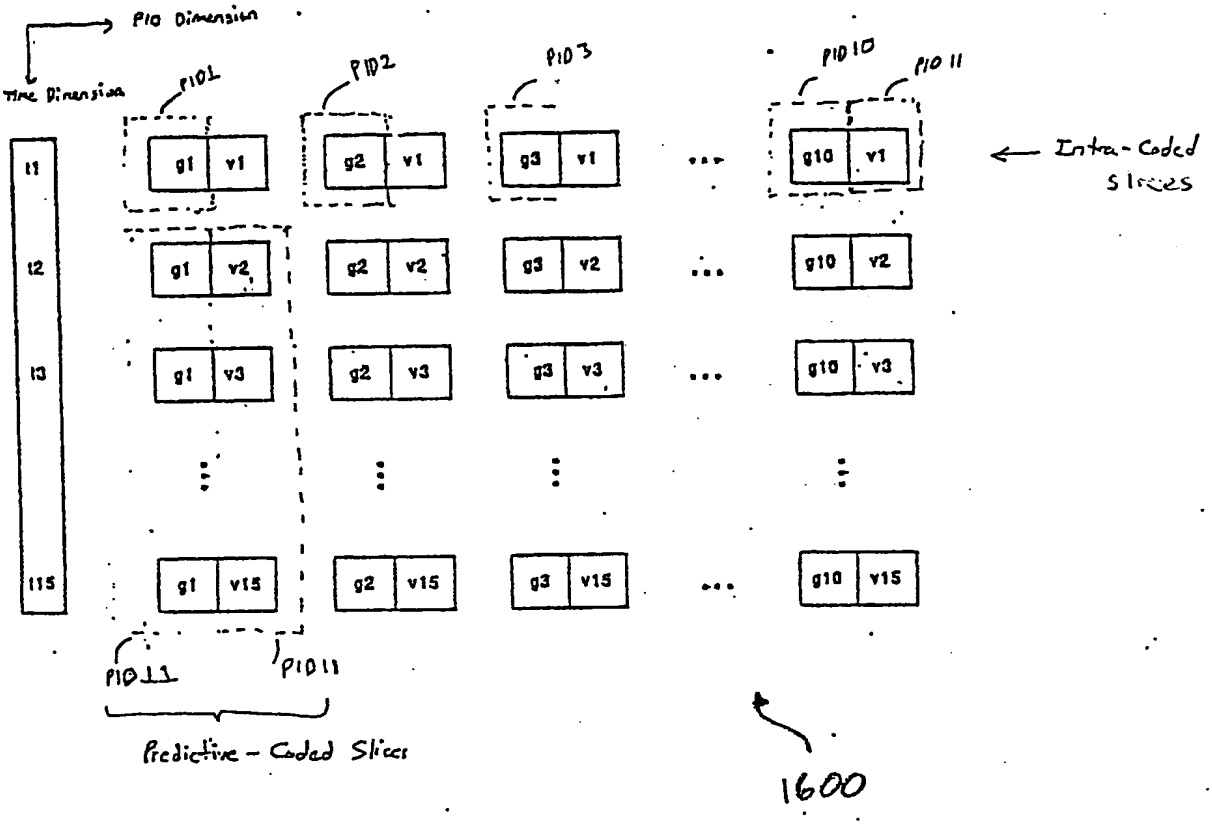

PID Dimension
Time Dimension
PID1
PID2
PID3
PID10
PID 11
t1
t2
t3
t15
g1
v1
g2
g3
g10
v2
v3
v15
Intra-Coded Slices
PID11
PID11
Predictive-Coded Slices
1600

Figure 16

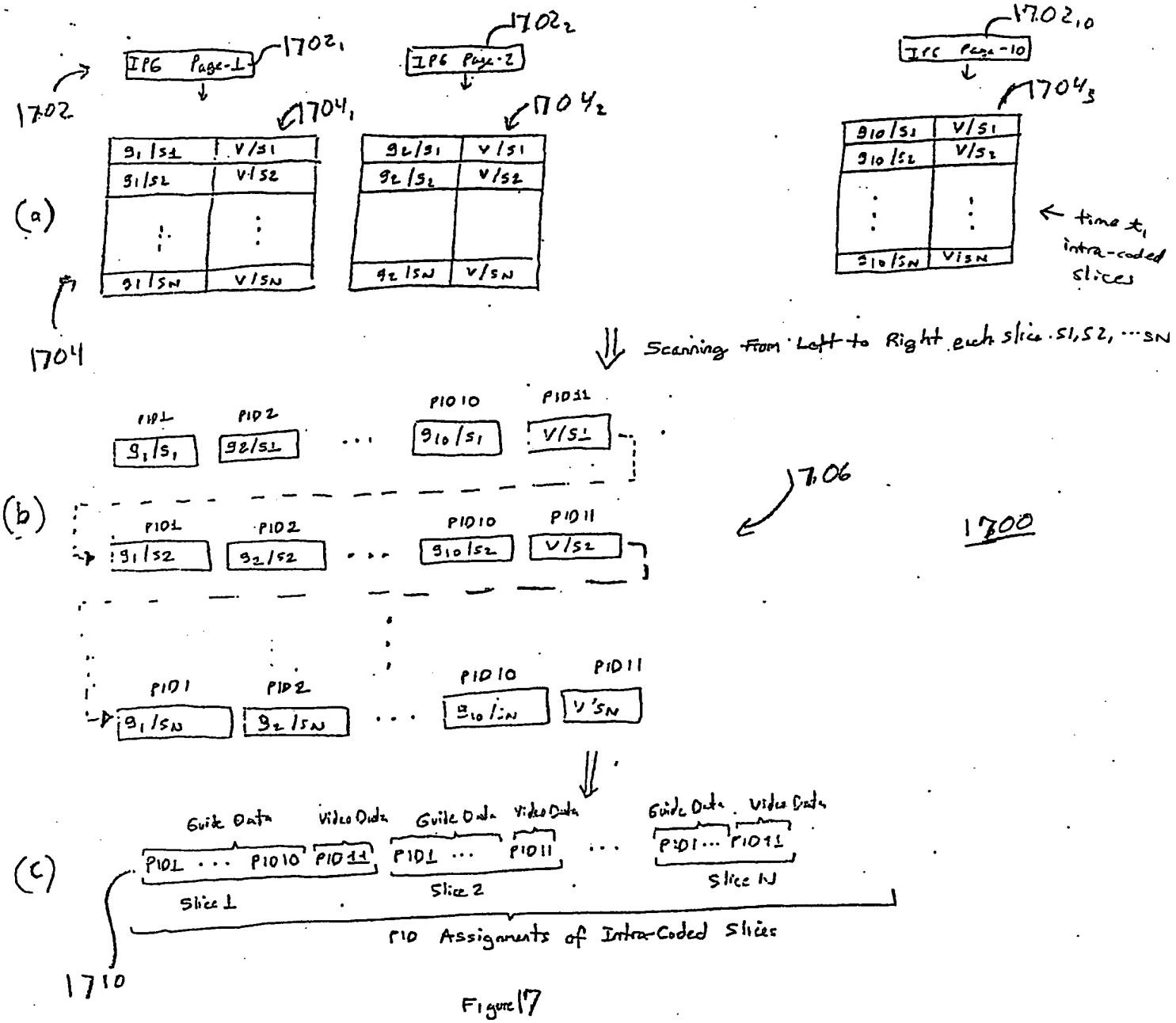

1702
IPG Page-1
1702₁
IPG Page-2
1702₂
IPG Page-10
1702₁₀
1704₁
1704₂
1704₃
(a)
g1/s1 | V/s1
g1/s2 | V/s2
g1/sN | V/sN
g2/s1 | V/s1
g2/s2 | V/s2
g2/sN | V/sN
g10/s1 | V/s1
g10/s2 | V/s2
g10/sN | V/sN
← time t1 intra-coded slices
1704
Scanning from Left to Right each slice S1, S2, ... SN
(b)
1706
1700
PID1
PID2
PID10
PID11
g1/s1
g2/s1
g10/s1
V/s1
g1/s2
g2/s2
g10/s2
V/s2
g1/sN
g2/sN
g10/sN
V/sN
(c)
Guide Data
Video Data
Slice 1
Slice 2
Slice N
PID Assignments of Intra-Coded Slices
1710

Figure 17

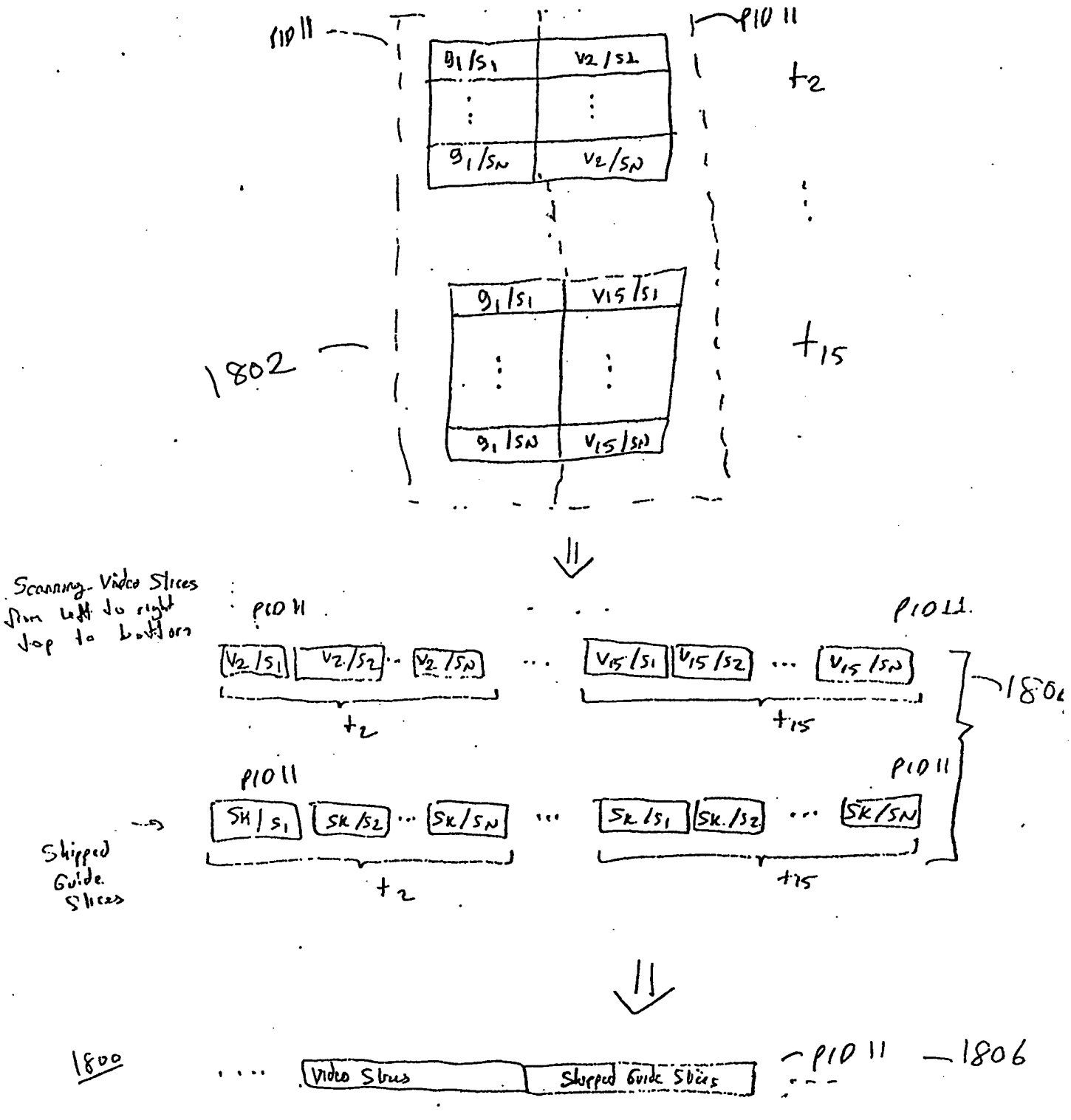

PID 11
PID 11
g_1/s_1
v_2/s_2
t_2
g_1/s_N
v_2/s_N
g_1/s_1
v_{15}/s_1
1802
t_{15}
g_1/s_N
v_{15}/s_N
Scanning Video Slices
Slice left to right
top to bottom
PID 11
PID 11
v_2/s_1
v_2/s_2
v_2/s_N
v_{15}/s_1
v_{15}/s_2
v_{15}/s_N
1804
t_2
t_{15}
PID 11
PID 11
s_k/s_1
s_k/s_2
s_k/s_N
s_k/s_1
s_k/s_2
s_k/s_N
Skipped Guide Slices
t_2
t_{15}
1800
Video Slices
Skipped Guide Slices
PID 11
1806

Figure 18

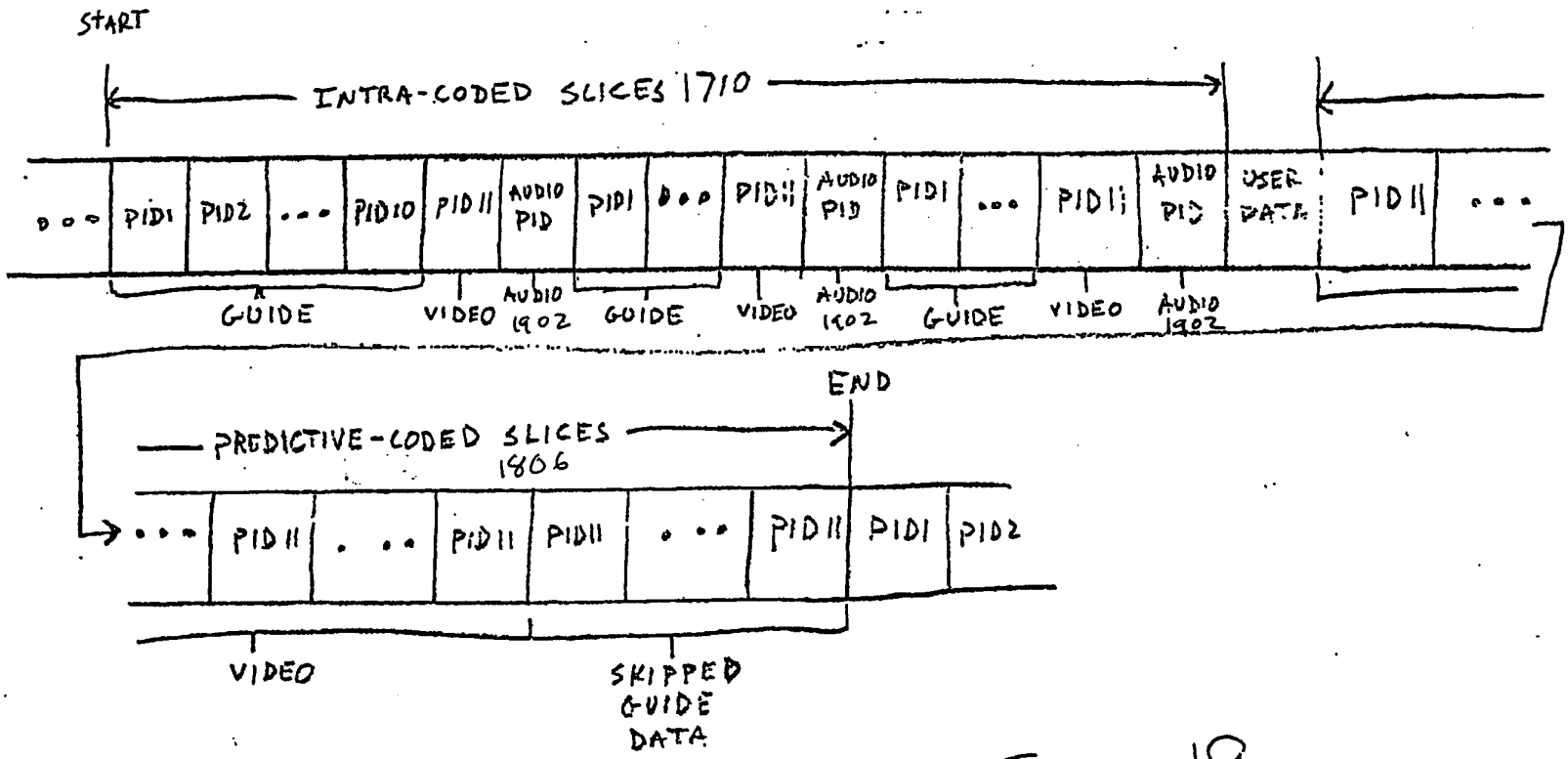

START
INTRA-CODED SLICES 1710
PID1
PID2
PID10
PID11
AUDIO PID
PID1
PID11
AUDIO PID
PID1
PID11
AUDIO PID
USER DATA
PID11
GUIDE
VIDEO
AUDIO 1902
GUIDE
VIDEO
AUDIO 1902
GUIDE
VIDEO
AUDIO 1902
END
PREDICTIVE-CODED SLICES 1806
PID11
PID11
PID11
PID11
PID11
PID1
PID2
VIDEO
SKIPPED GUIDE DATA

Figure 19

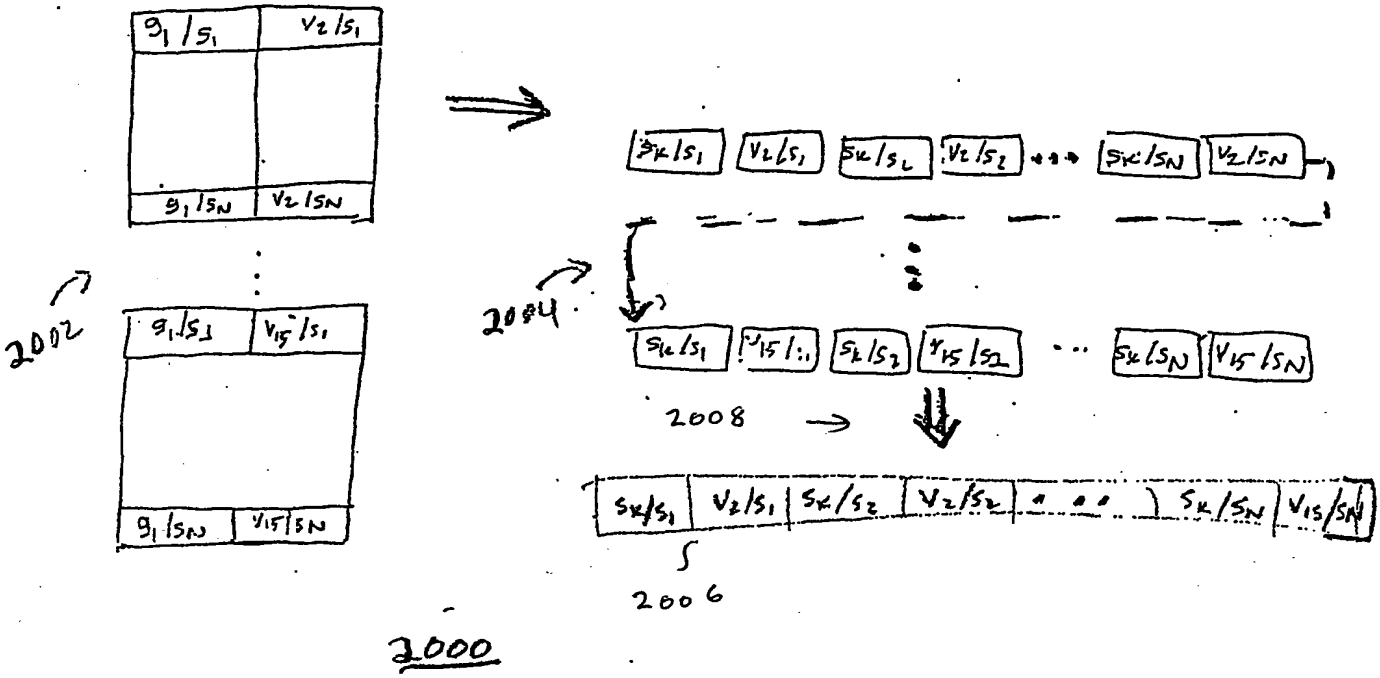


Figure 20

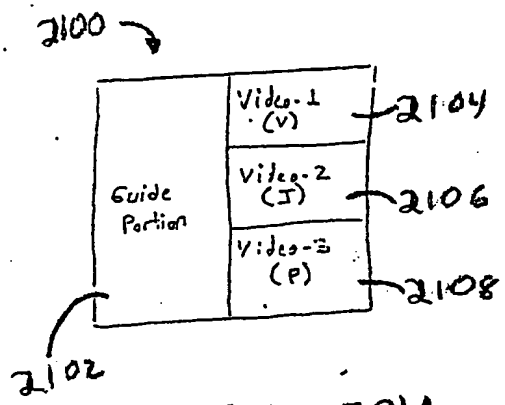


FIGURE 21A

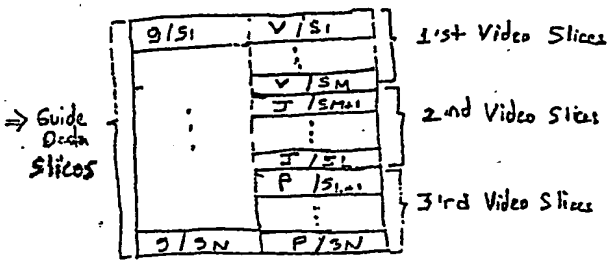


Figure 21B

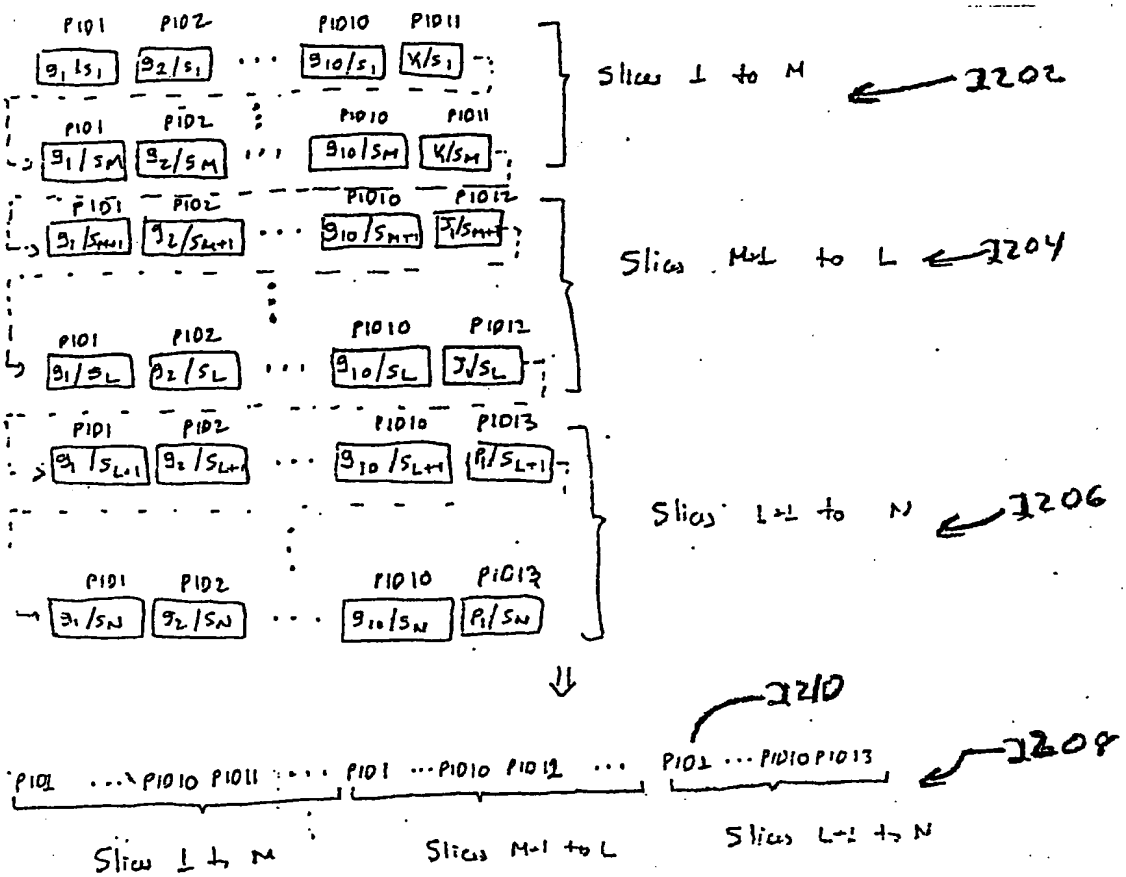
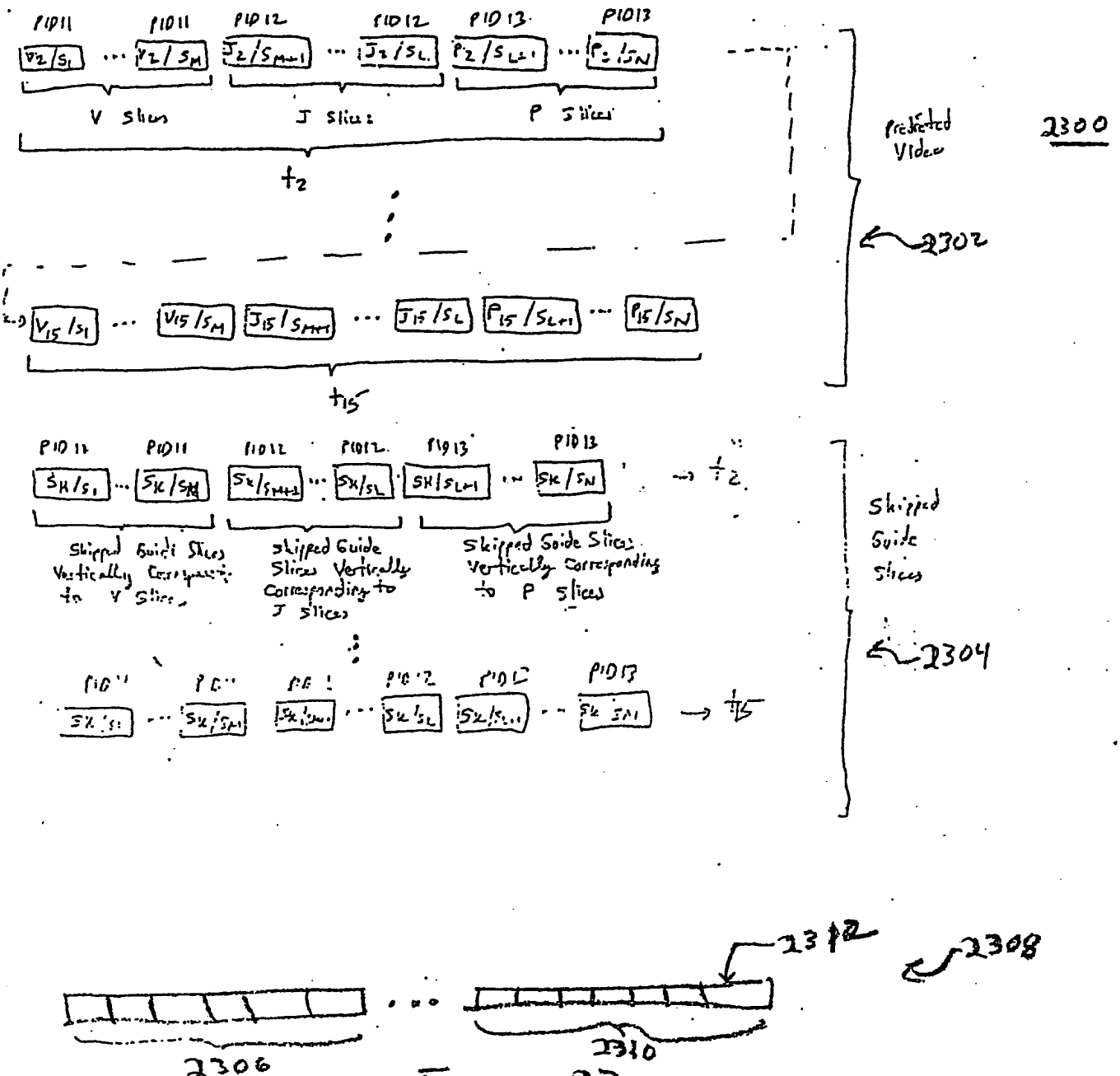

PID1
PID2
PID10
PID11
PID12
PID13
Slices 1 to M
Slices M+1 to L
Slices L+1 to N
1202
1204
1206
1200
1208
1210

Figure 12


PID11
PID11
PID12
PID12
PID13
PID13
V Slices
J Slices
P Slices
t2
t15
Predicted Video
2300
2302
Skipped Guide Slices Vertically Corresponding to V Slices
Skipped Guide Slices Vertically Corresponding to J Slices
Skipped Guide Slices Vertically Corresponding to P Slices
Skipped Guide Slices
2304

2312
2308
2306
2310

Figure 23

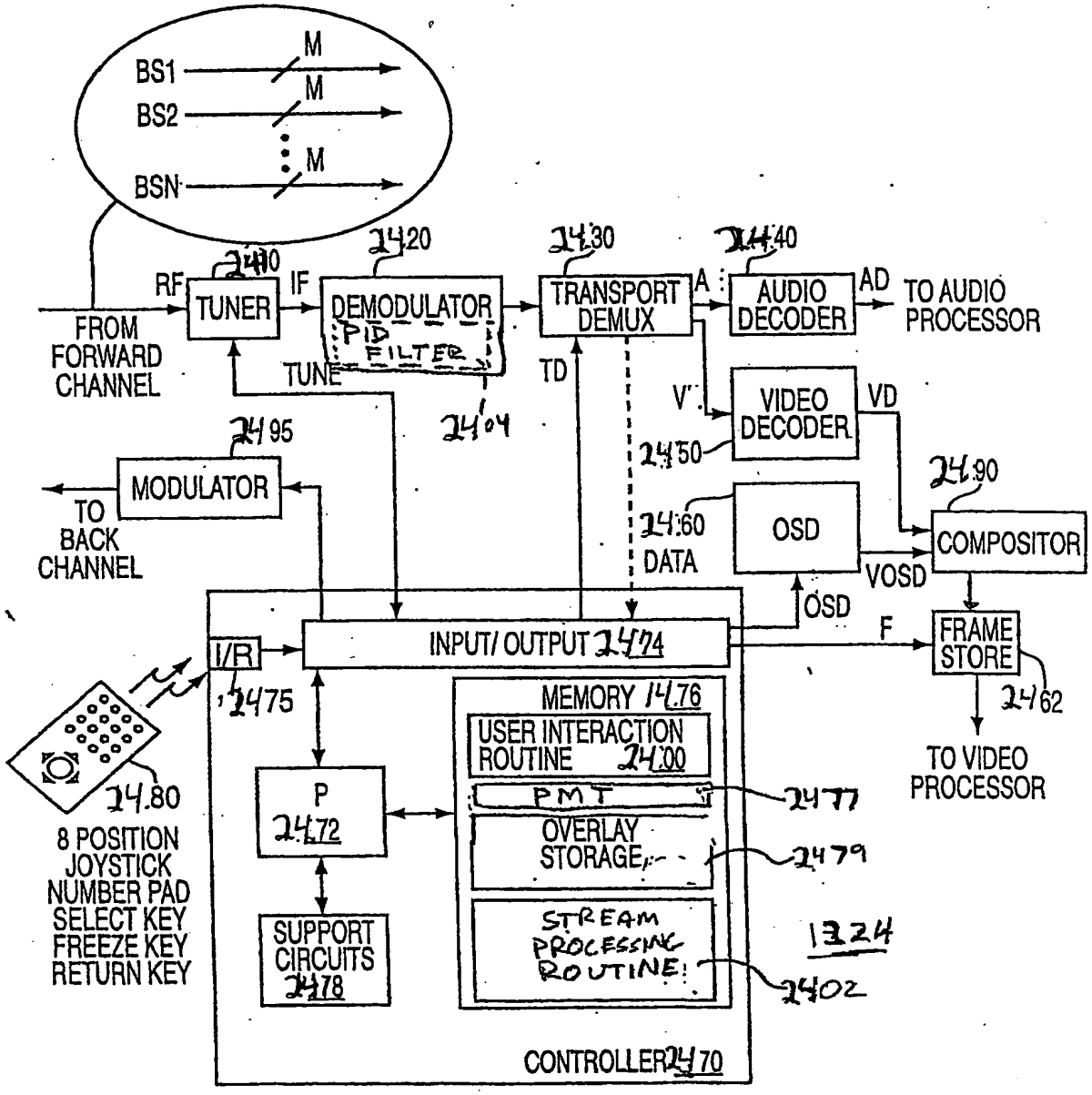

BS1
BS2
BSN
M
M
M
FROM FORWARD CHANNEL
RF
TUNER
IF
DEMODULATOR
PID FILTER
TUNE
TRANSPORT DEMUX
A
AUDIO DECODER
AD
TO AUDIO PROCESSOR
TD
V
VIDEO DECODER
VD
MODULATOR
TO BACK CHANNEL
OSD
DATA
COMPOSITOR
VOSD
OSD
F
FRAME STORE
TO VIDEO PROCESSOR
I/R
INPUT/ OUTPUT 2474
MEMORY 1476
USER INTERACTION ROUTINE 2400
PMT
OVERLAY STORAGE
STREAM PROCESSING ROUTINE
P 2472
SUPPORT CIRCUITS 2478
CONTROLLER 2470
8 POSITION JOYSTICK
NUMBER PAD
SELECT KEY
FREEZE KEY
RETURN KEY

Figure 24

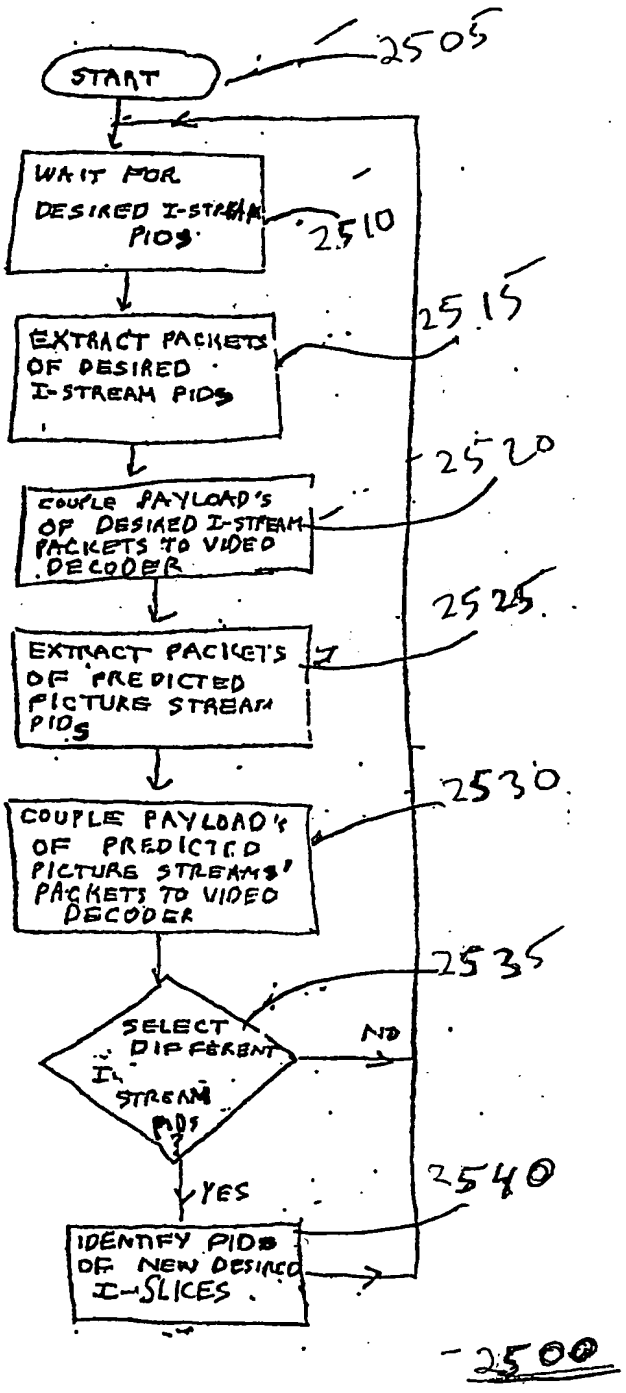

START
2505
WAIT FOR DESIRED I-STREAM PIDS
2510
EXTRACT PACKETS OF DESIRED I-STREAM PIDS
2515
COUPLE PAYLOAD'S OF DESIRED I-STREAM PACKETS TO VIDEO DECODER
2520
EXTRACT PACKETS OF PREDICTED PICTURE STREAM PIDS
2525
COUPLE PAYLOAD'S OF PREDICTED PICTURE STREAMS' PACKETS TO VIDEO DECODER
2530
SELECT DIFFERENT I-STREAM PIDS?
2535
NO
YES
IDENTIFY PIDS OF NEW DESIRED I-SLICES
2540
2500

Figure 25

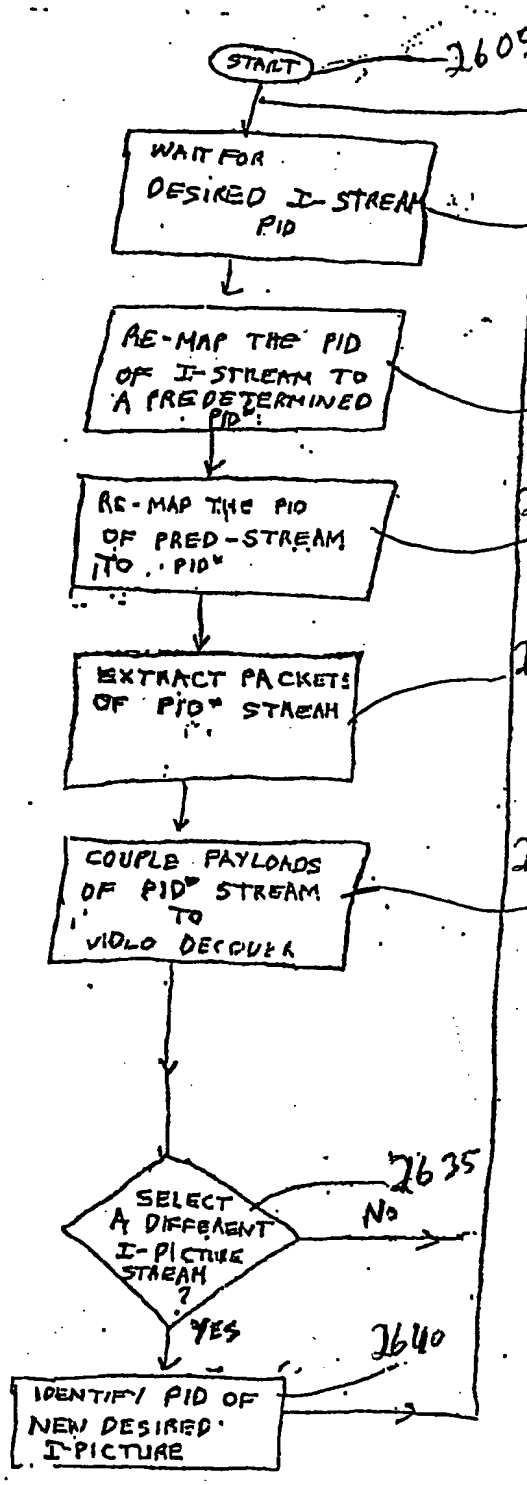

START
2605
WAIT FOR DESIRED I-STREAM PID
2610
RE-MAP THE PID OF I-STREAM TO A PREDETERMINED PID
2615
RE-MAP THE PID OF PRED-STREAM TO "PID"
2620
EXTRACT PACKETS OF "PID" STREAM
2625
COUPLE PAYLOADS OF "PID" STREAM TO VIDEO DECODER
2630
SELECT A DIFFERENT I-PICTURE STREAM ?
2635
NO
YES
IDENTIFY PID OF NEW DESIRED I-PICTURE
2640
2600

Figure 26

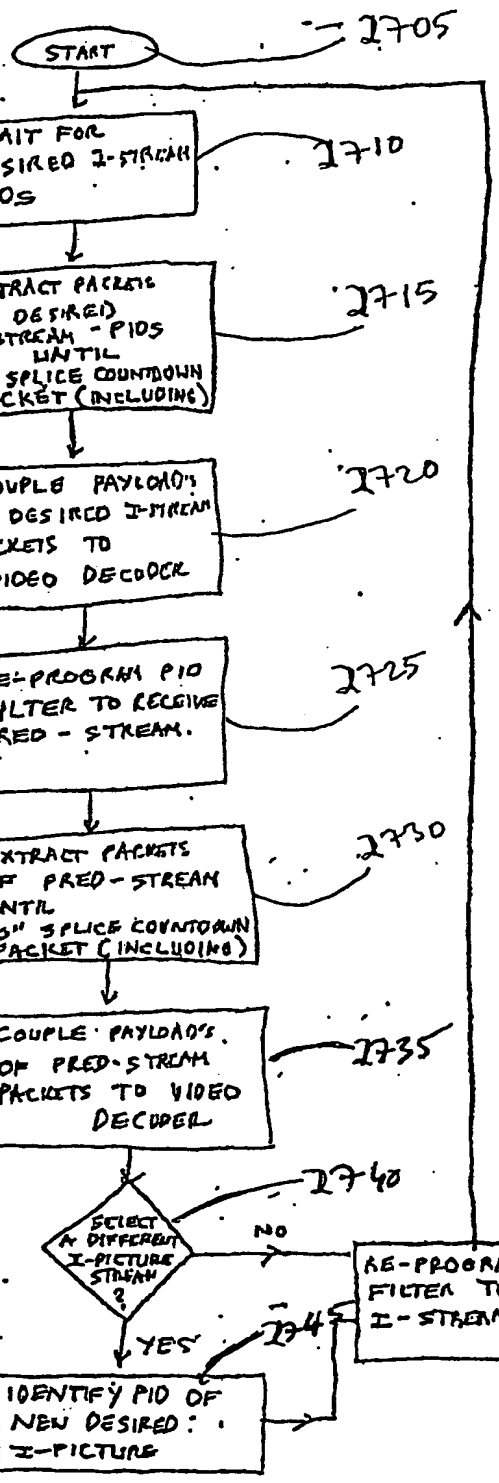


Figure 27

2700

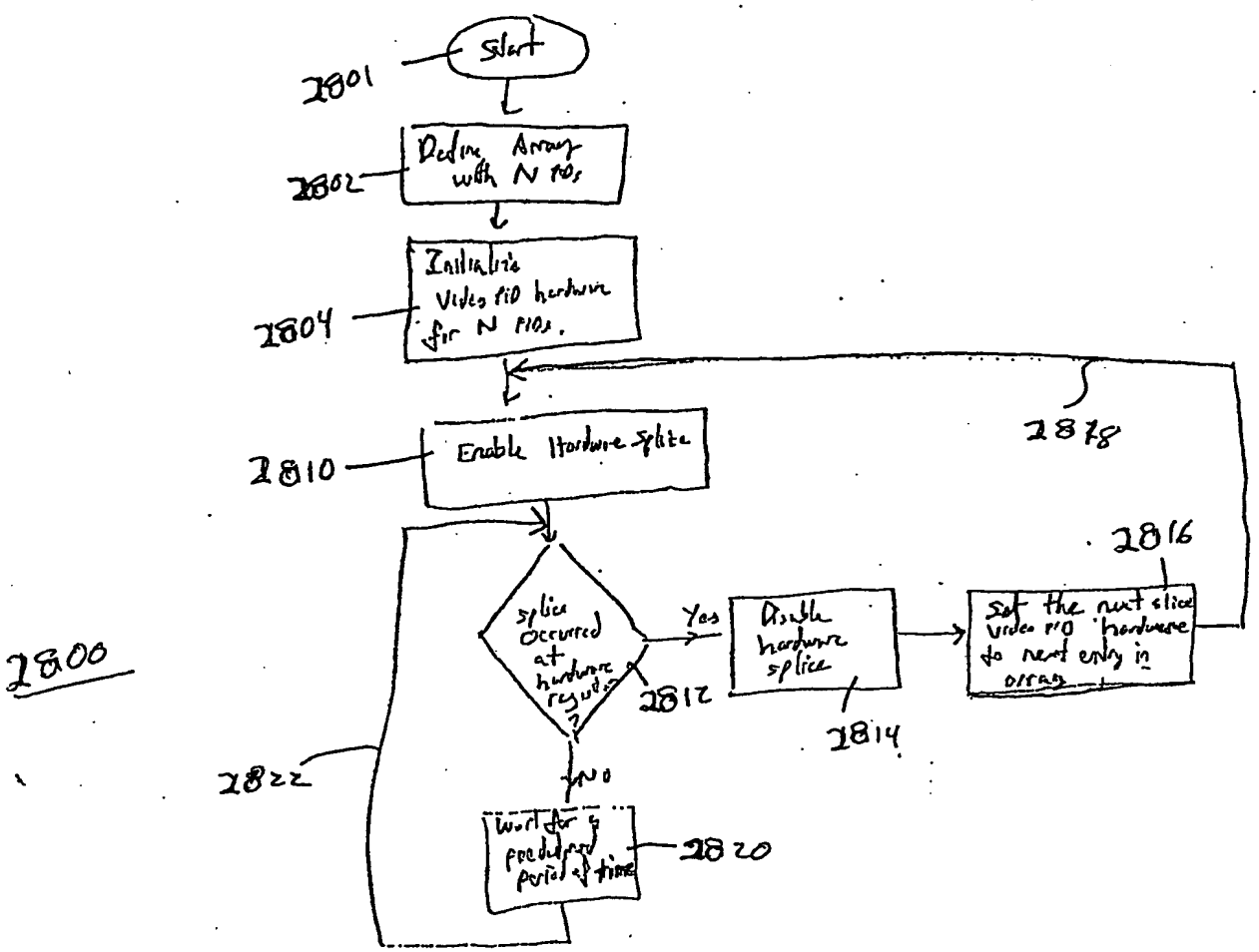
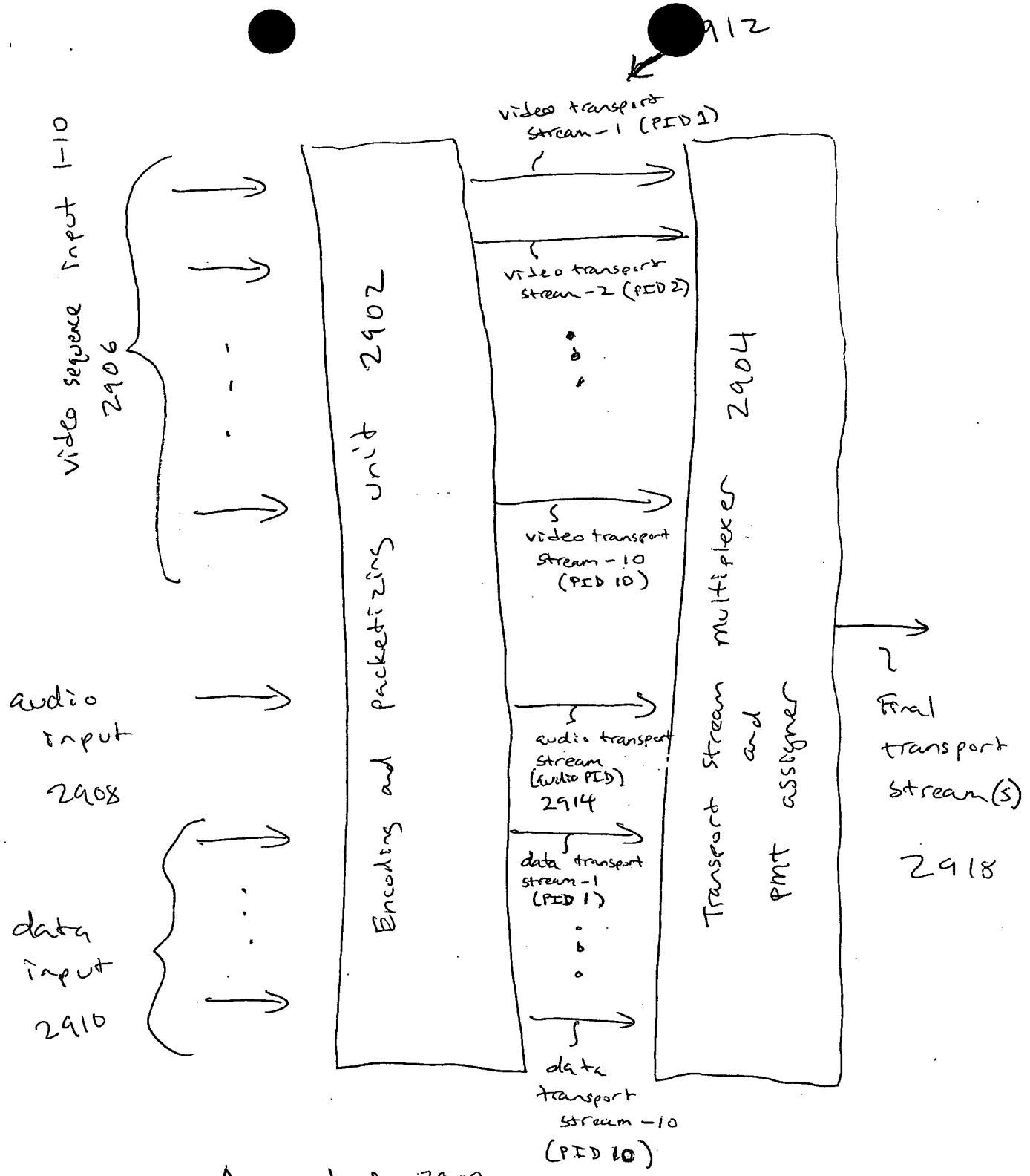
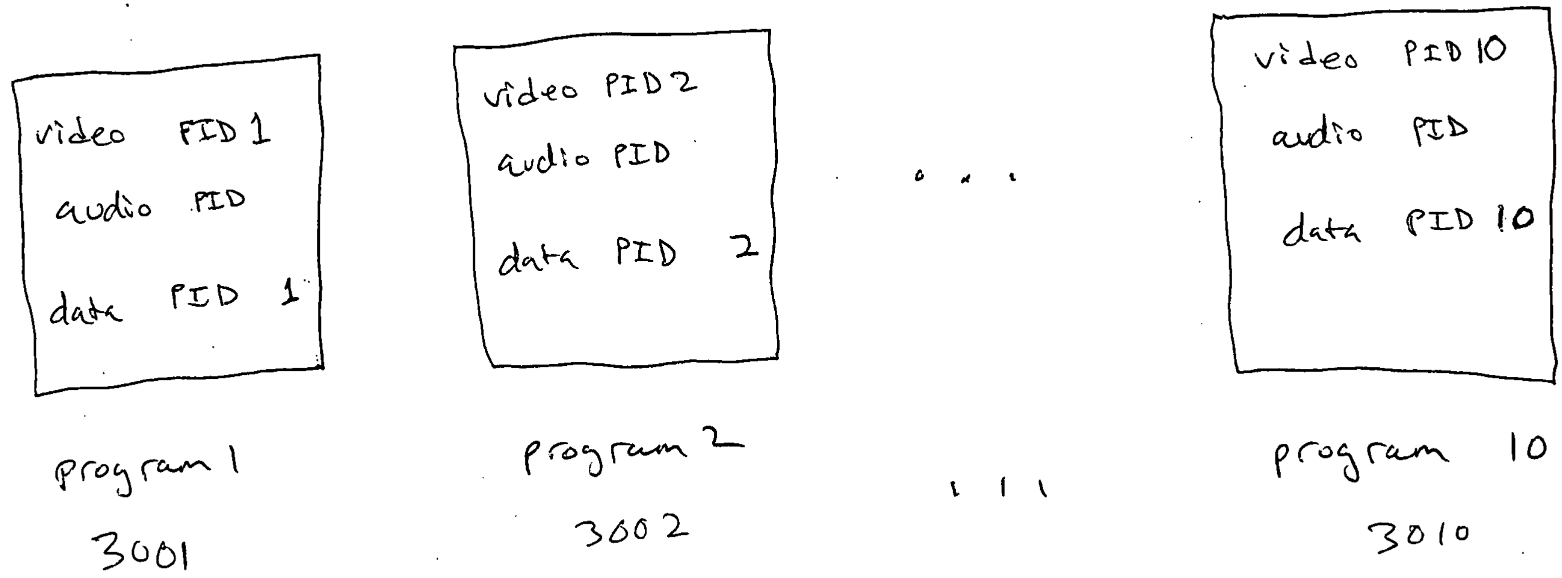

2800
2801
Start
2802
Define Array with N ptrs
2804
Initialize Video PIO hardware for N PIOs.
2810
Enable Hardware Splice
2808
2812
splice occurred at hardware register?
Yes
2814
Disable hardware splice
2816
Set the next slice video PIO hardware to next entry in array
No
2822
2820
Wait for predefined period of time

Figure 28



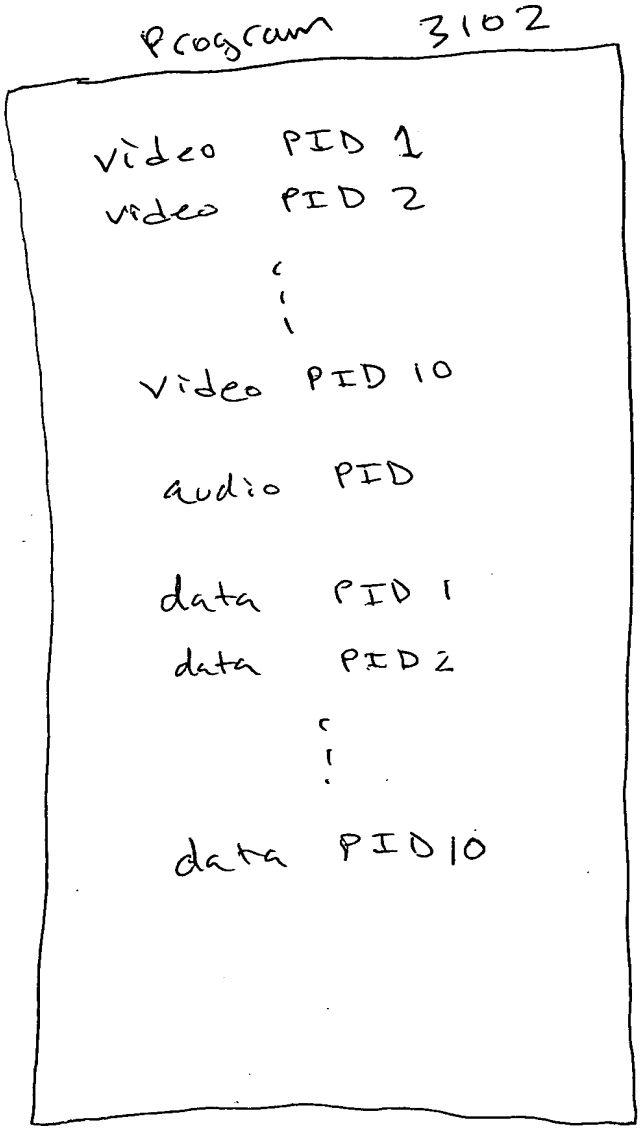
Apparatus 2900

Fig. 29

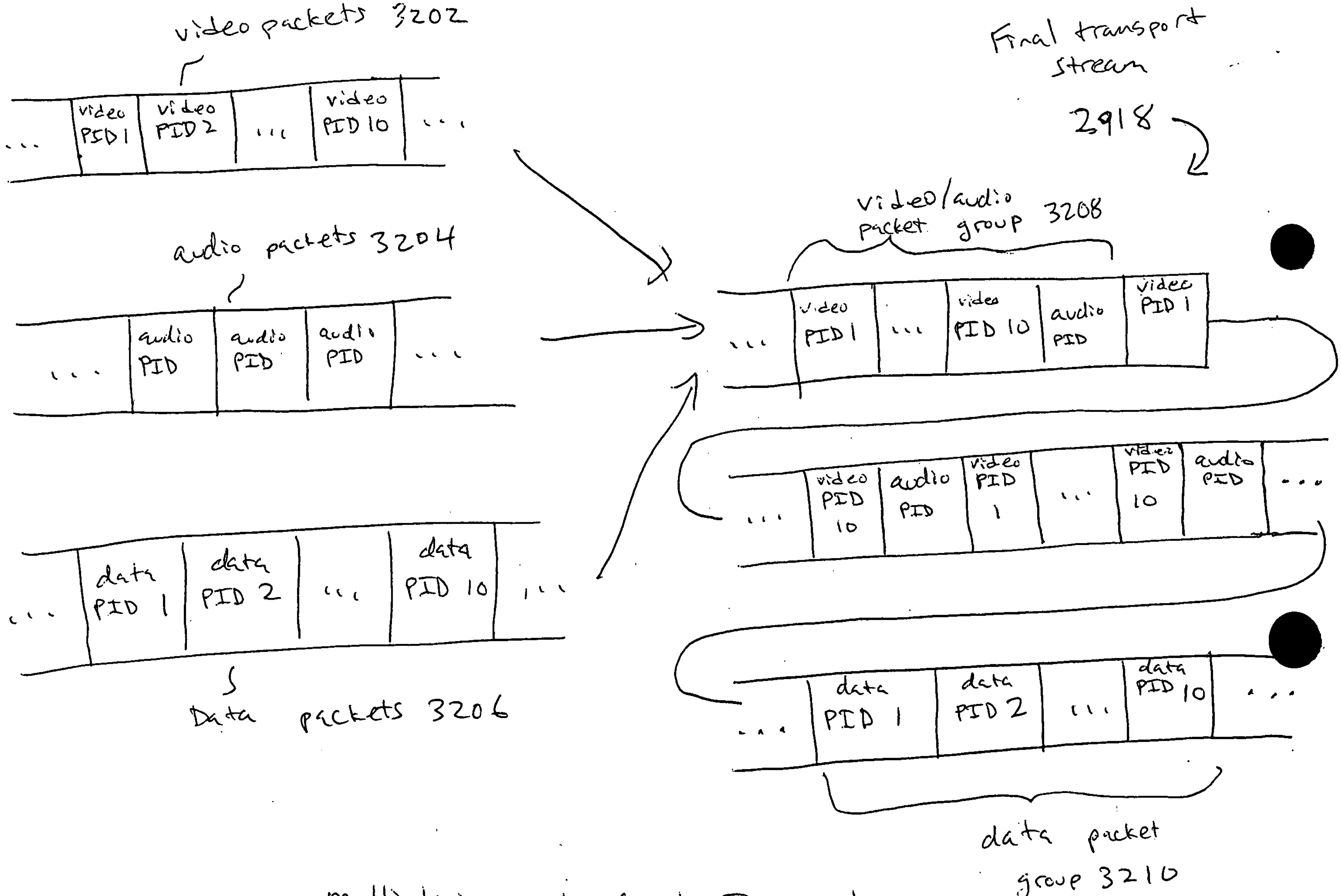


Single Transport, multiple Program Assignment 3000

Fig. 30

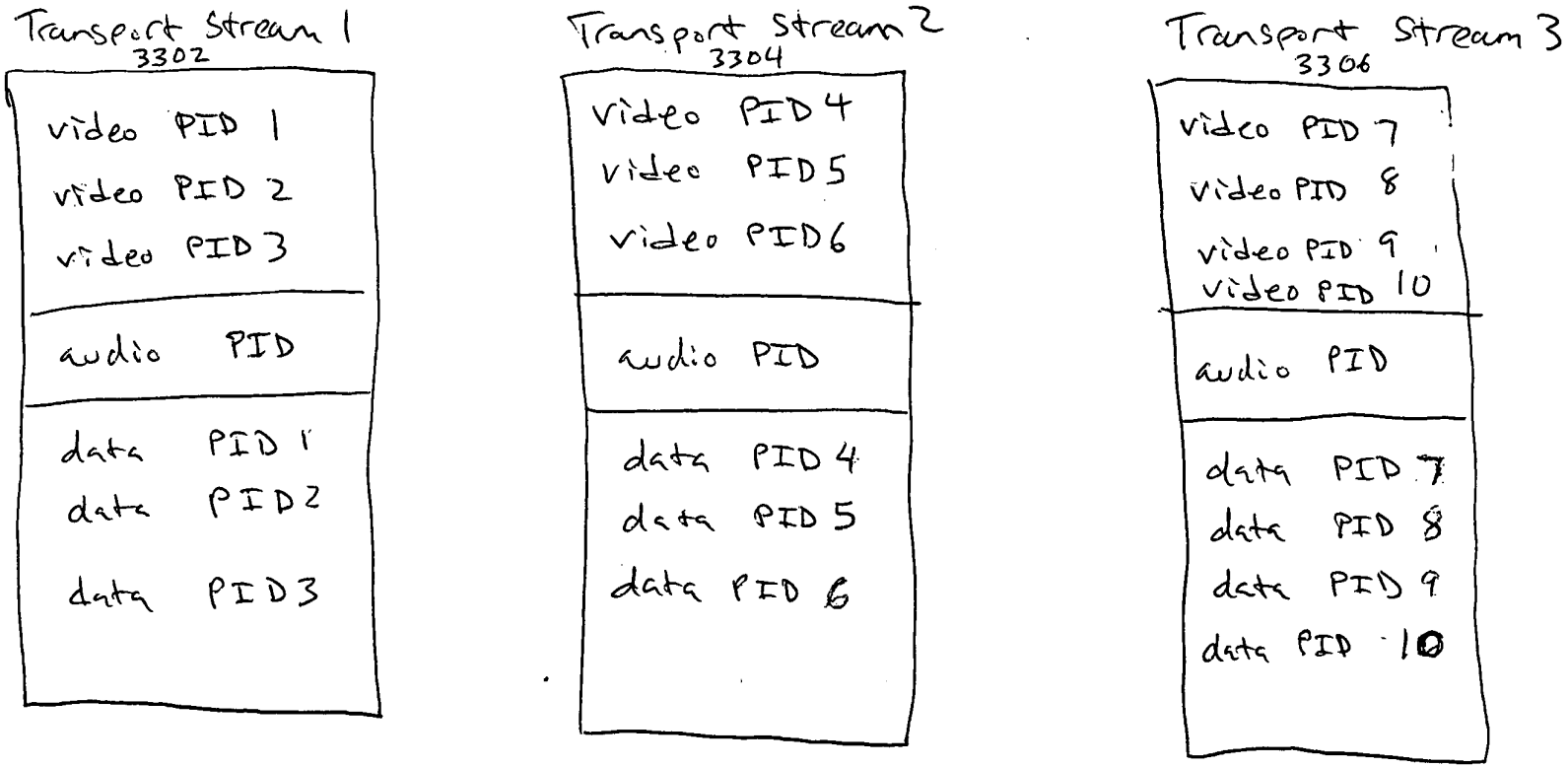


Single Transport, Single Program
Program Assignment 3100
Fig. 31



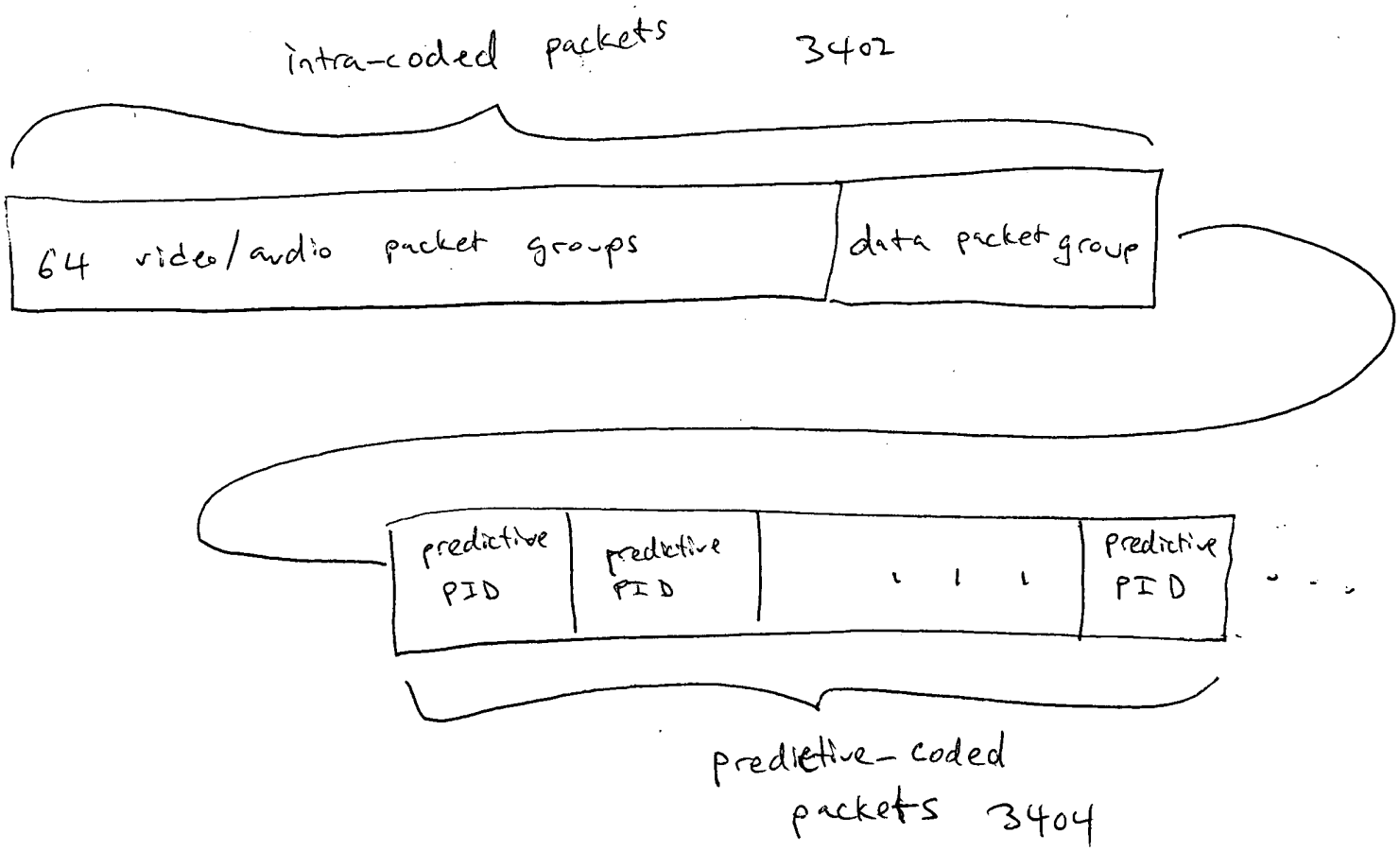
Multiplexing into Single Transport

Fig. 32



Multiple Transport Assignment Structure 3300

Fig. 33



Final Transport Stream 3400

Fig. 34

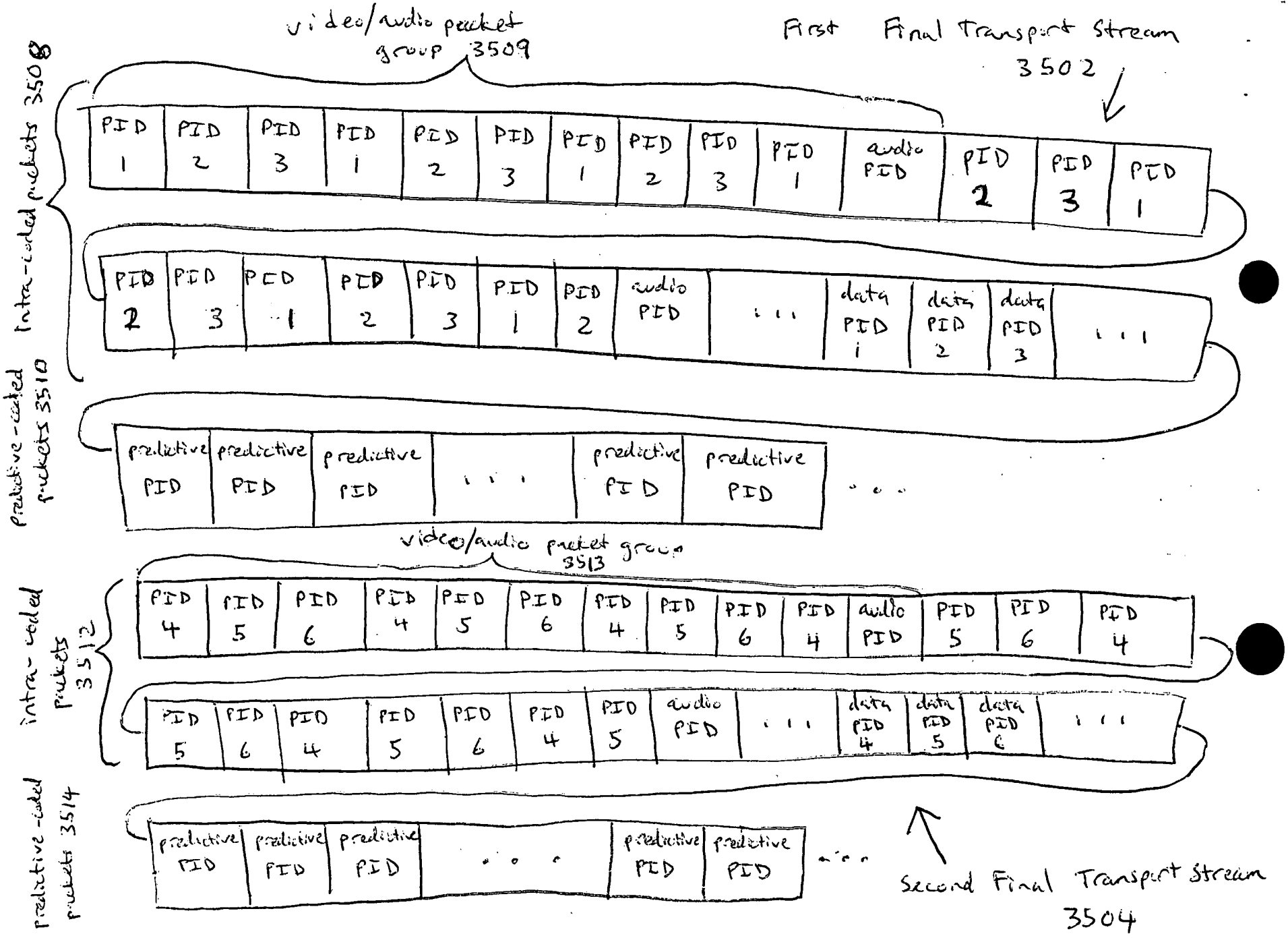

video/audio packet group 3509
First Final Transport Stream 3502
Intra-coded packets 3508
Predictive-coded packets 3510
video/audio packet group 3513
Intra-coded packets 3512
Predictive-coded packets 3514
Second Final Transport Stream 3504

Fig. 35A

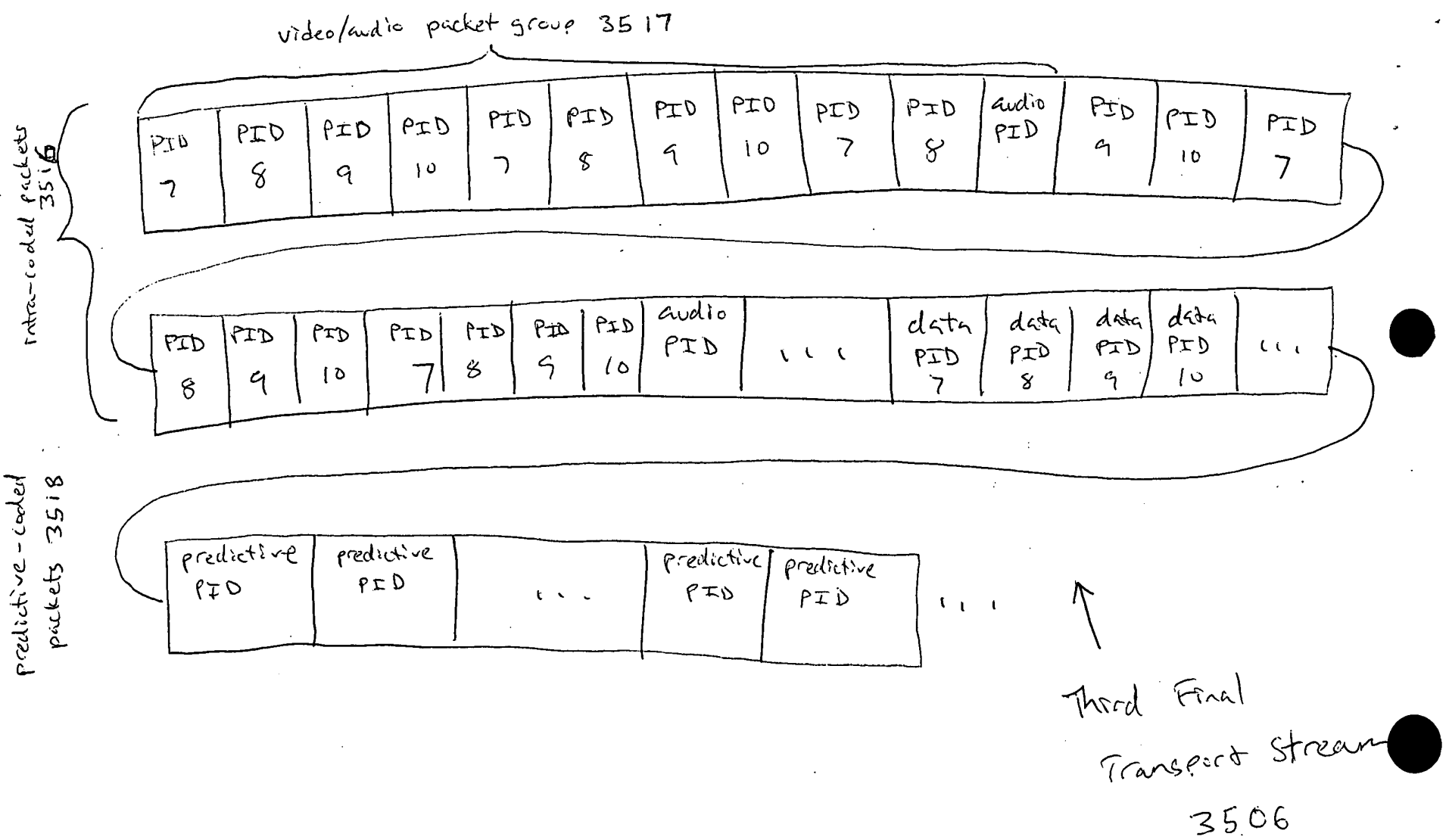
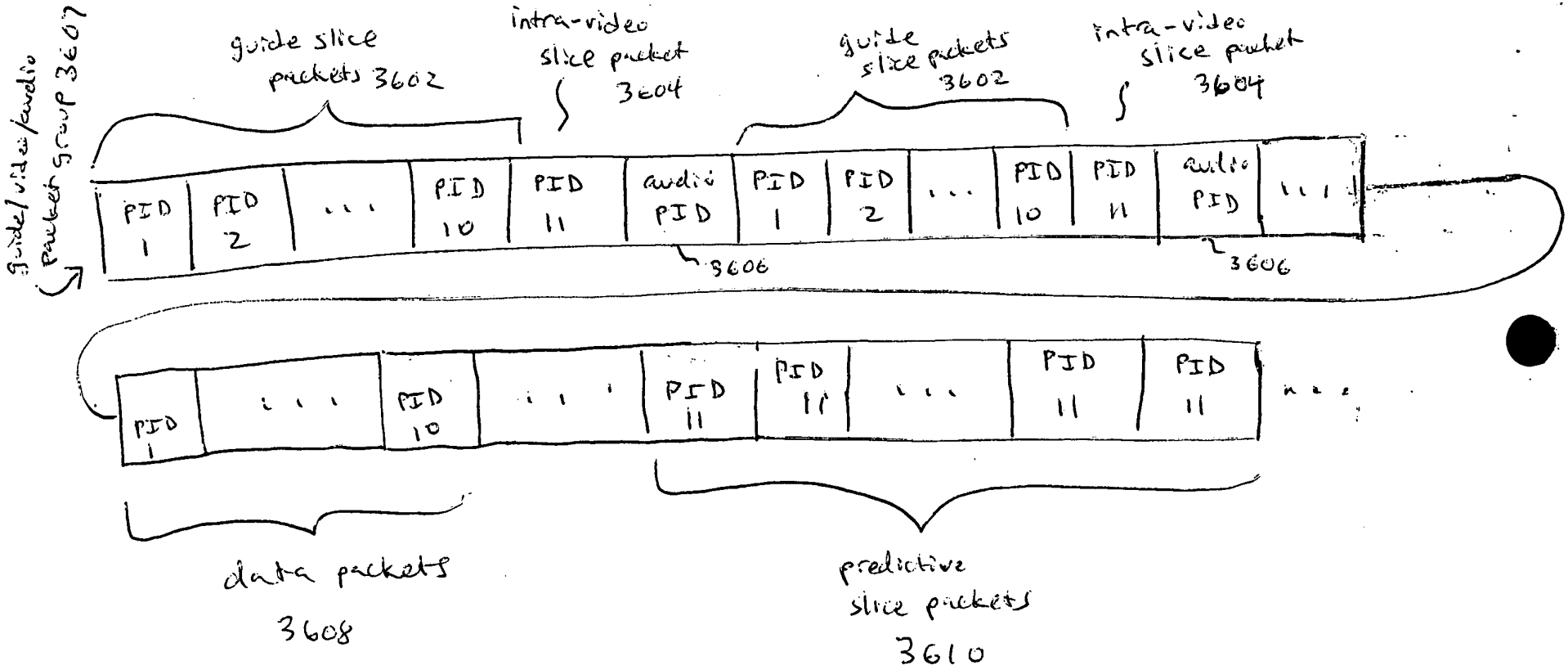


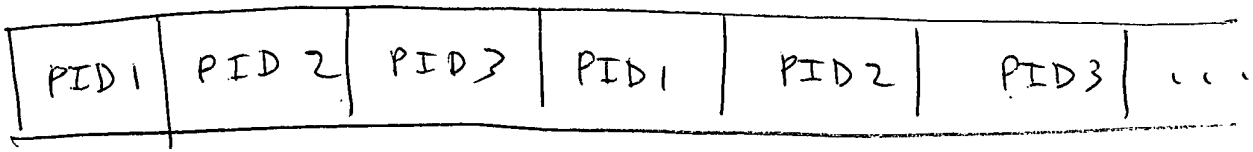
Fig. 35B

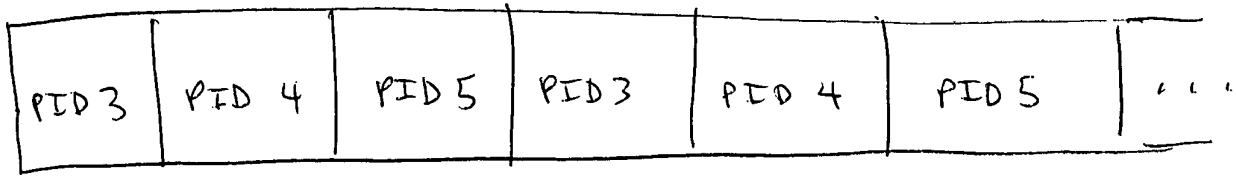


Final Transport Stream 3600

Fig. 36

First Transport Stream
3702





Second Transport Stream
3704

Fig. 37

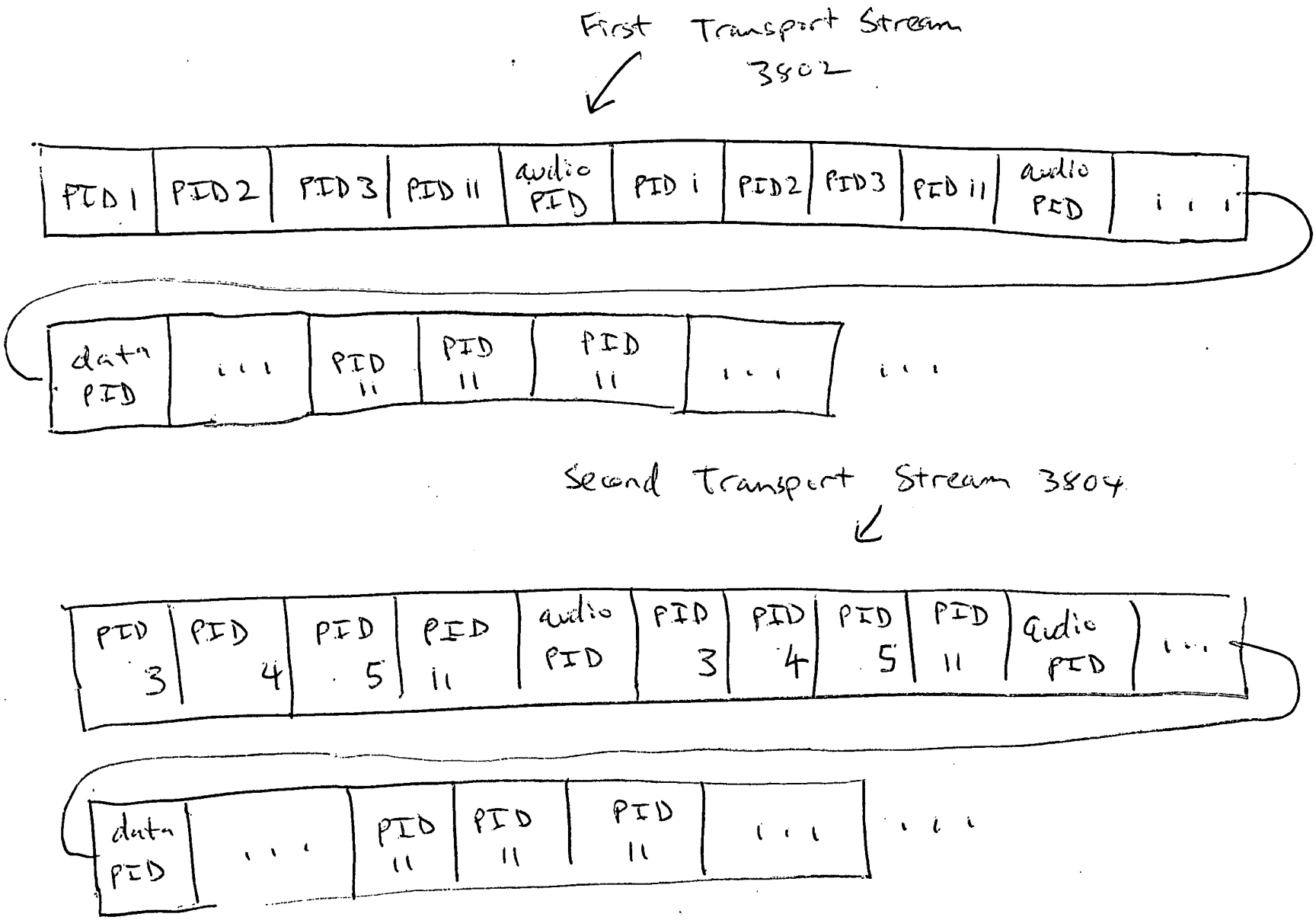

First Transport Stream
3502
PID 1
PID 2
PID 3
PID 11
audio PID
PID i
PID 2
PID 3
PID 11
audio PID
i i i
data PID
i i i
PID 11
PID 11
PID 11
i i i
i i i
Second Transport Stream 3504
PID 3
PID 4
PID 5
PID 11
audio PID
PID 3
PID 4
PID 5
PID 11
audio PID
i i i
data PID
i i i
PID 11
PID 11
PID 11
i i i
i i i

Fig. 38

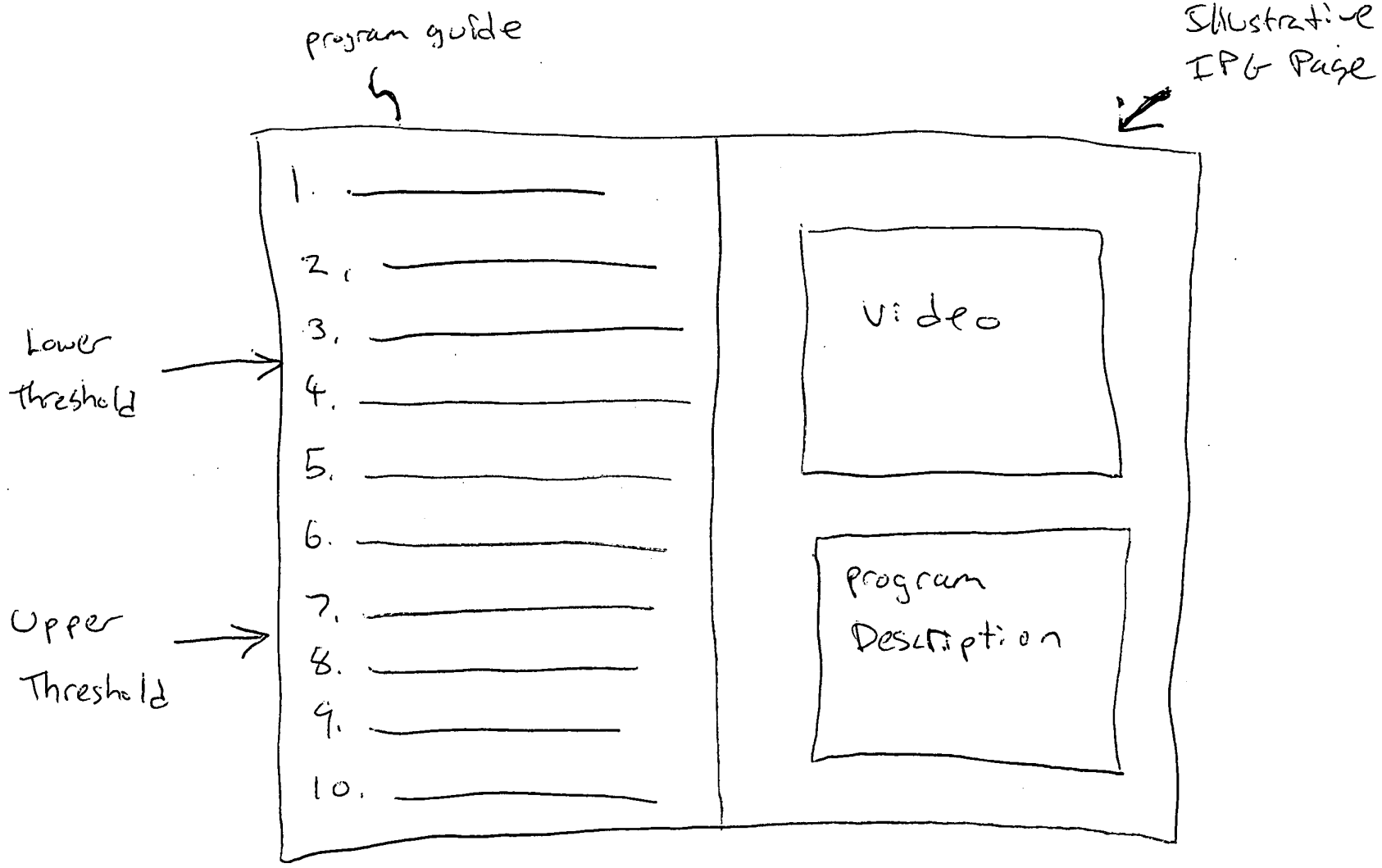

program guide
Illustrative IPG Page
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
Lower Threshold
Upper Threshold
Video
Program Description

Fig. 39

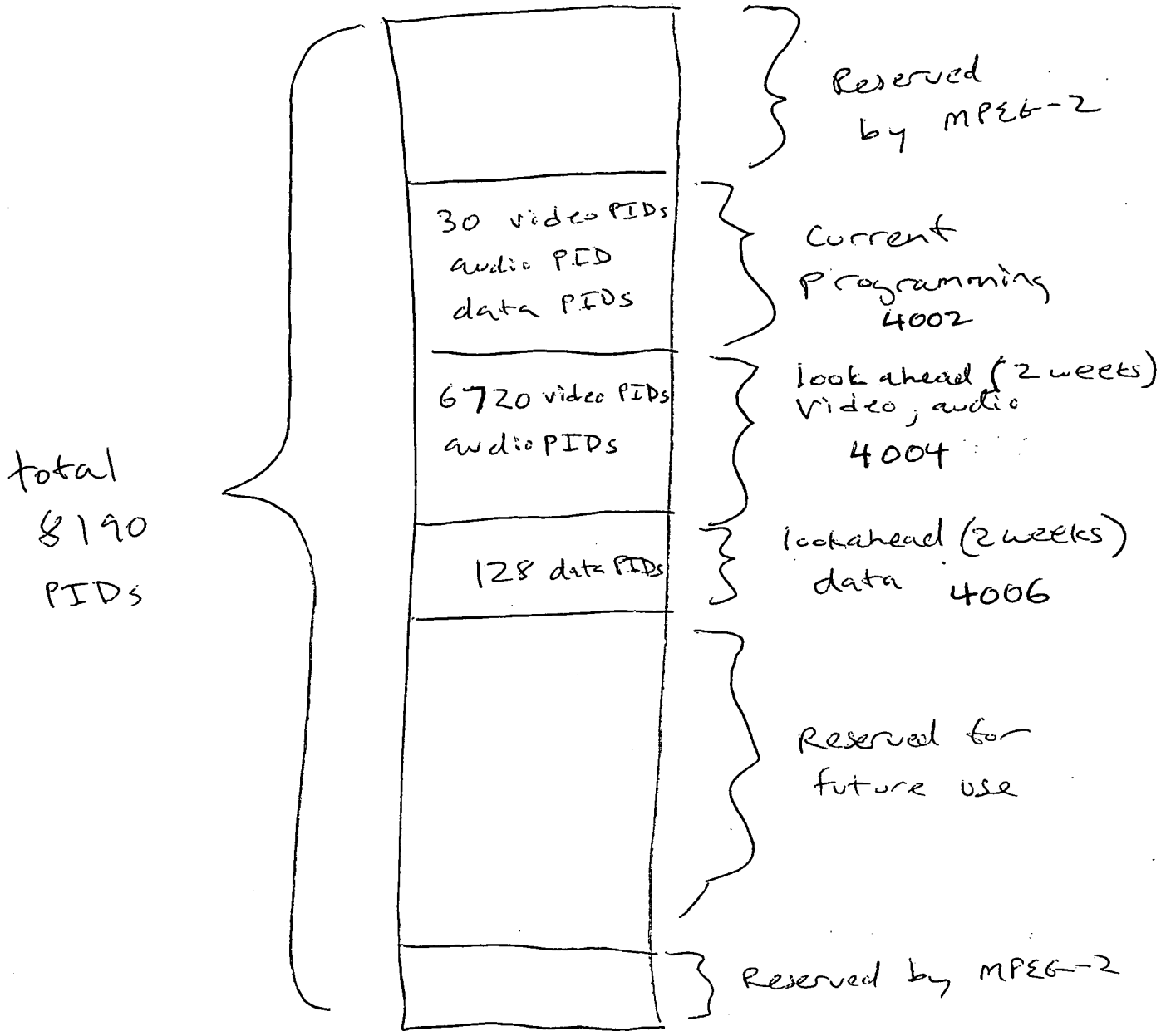
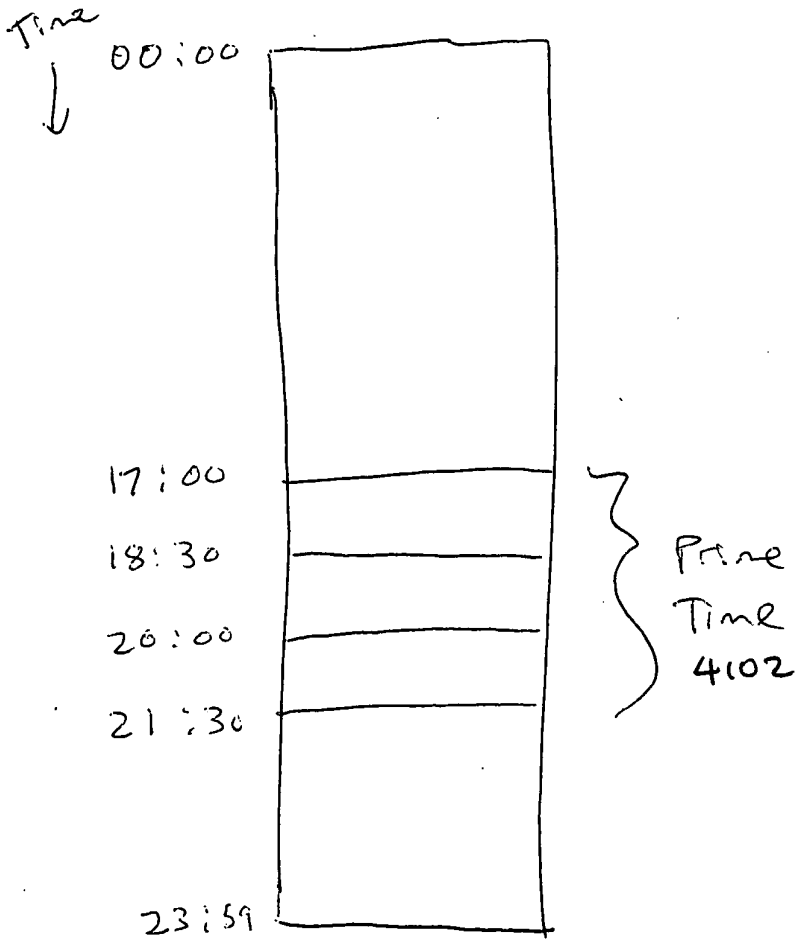
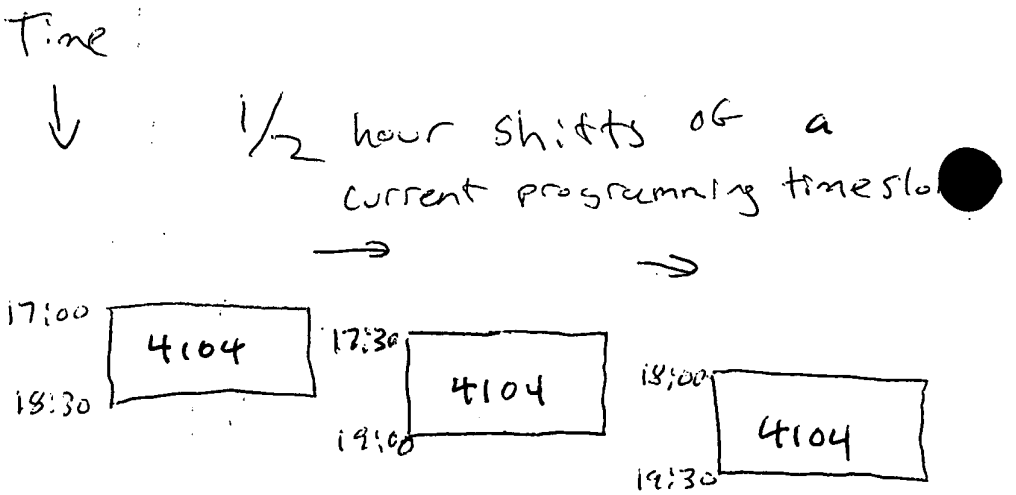

total
8190
PIDs
Reserved
by MPEG-2
30 video PIDs
audio PID
data PIDs
Current
Programming
4002
6720 video PIDs
audio PIDs
look ahead (2 weeks)
Video, audio
4004
128 data PIDs
lookahead (2 weeks)
data 4006
Reserved for
future use
Reserved by MPEG-2

Fig. 40


Time
00:00
17:00
18:30
20:00
21:30
23:59
Prime Time 4102

(a)


Time
1/2 hour shifts of a current programming timeslo
17:00
18:30
4104
17:30
19:00
4104
18:00
19:30
4104

(b)

Fig. 41

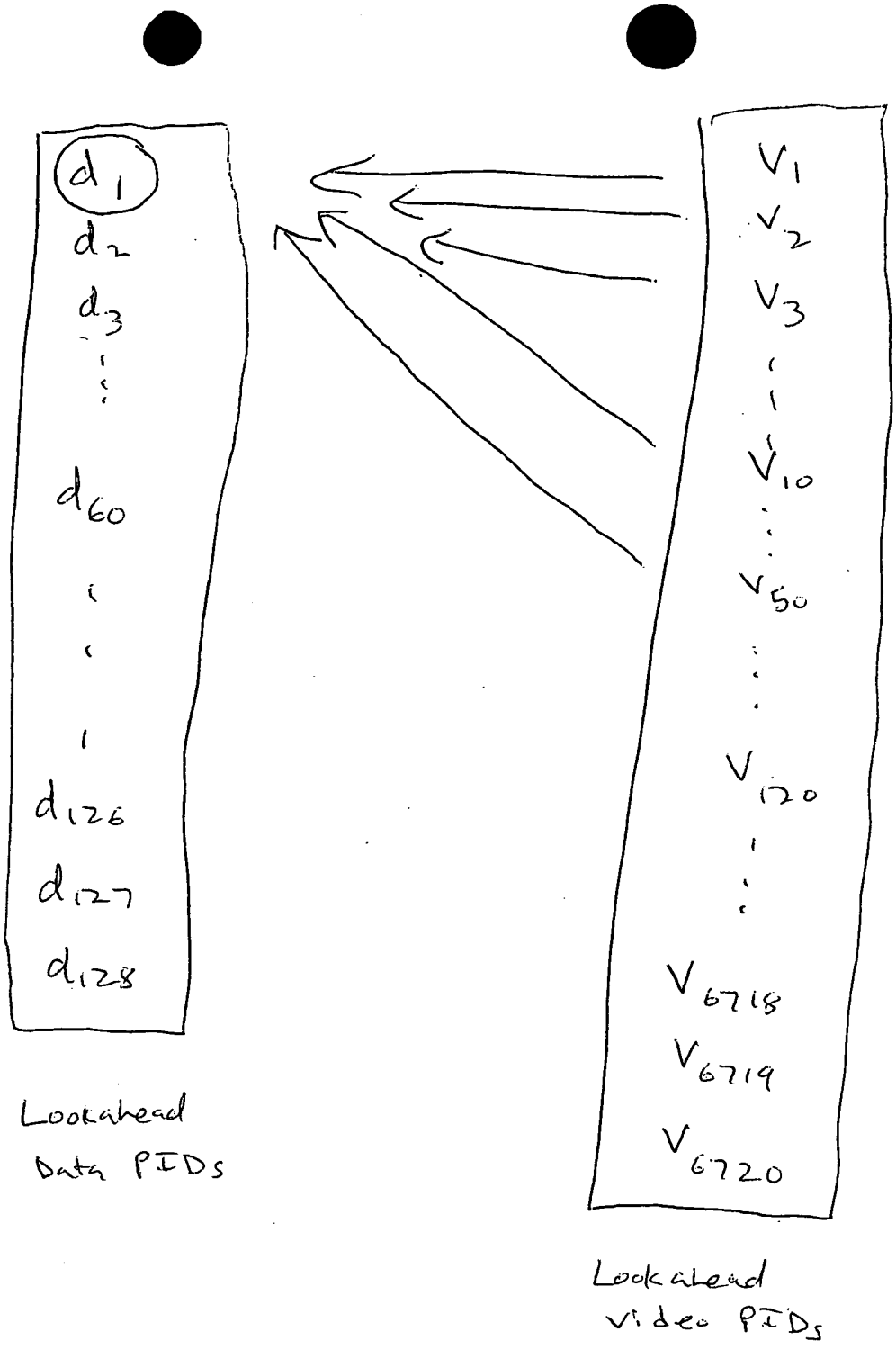

d_1
d_2
d_3
d_{60}
d_{126}
d_{127}
d_{128}
Lookahead Data PIDs
V_1
V_2
V_3
V_{10}
V_{50}
V_{120}
V_{6718}
V_{6719}
V_{6720}
Lookahead video PIDs

Fig. 42

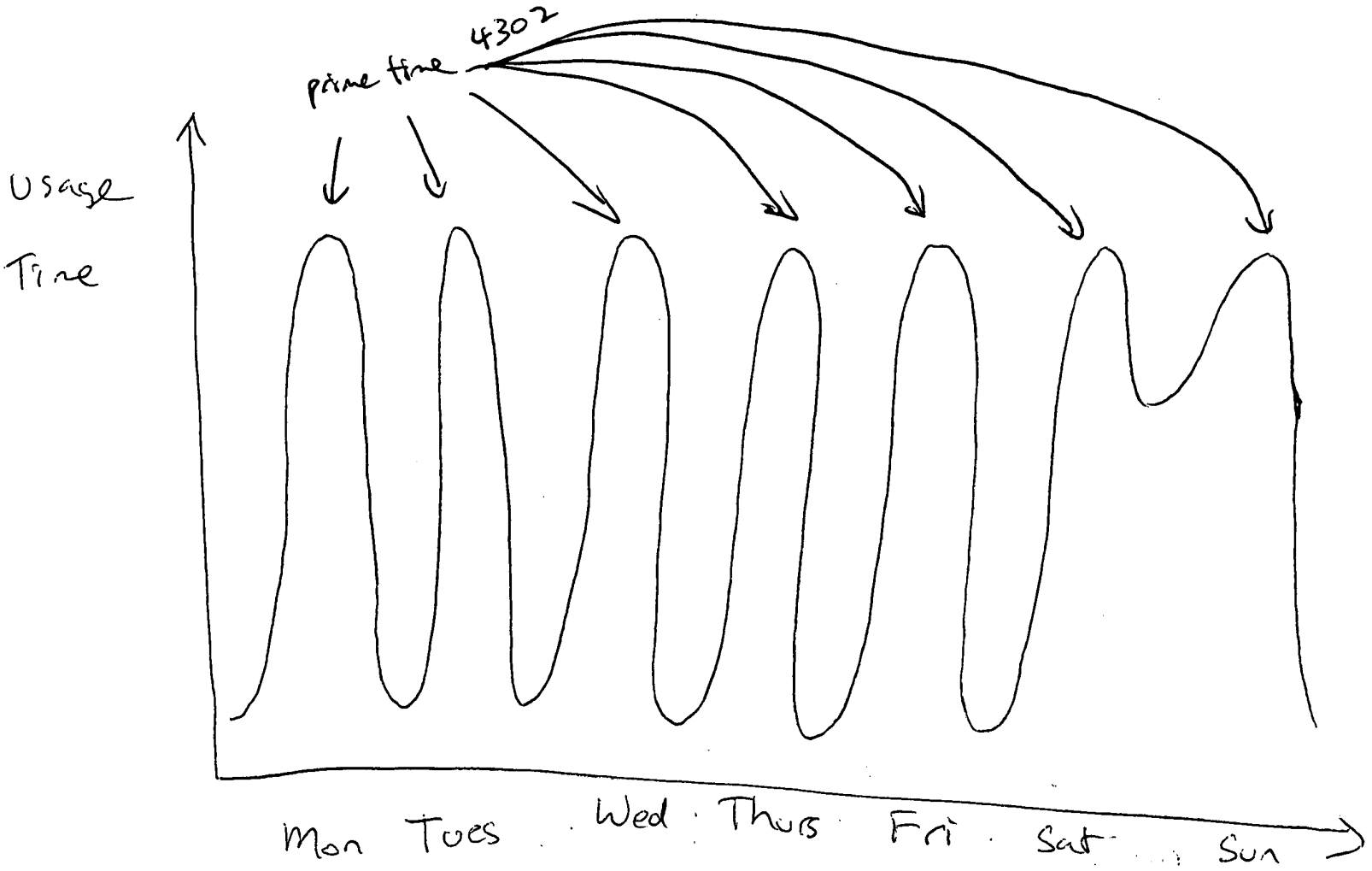
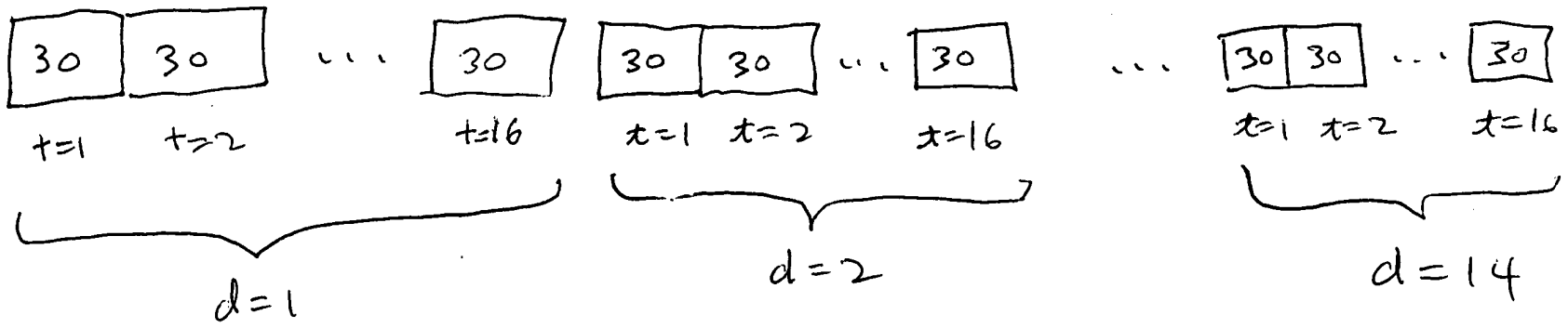

4302
prime time
Usage
Time
Mon
Tues
Wed
Thurs
Fri
Sat
Sun
Time of week

Fig. 43



4400

Fig. 44A

4422

largest prime # $\leq$ total # of data PIDs available

$\downarrow\downarrow$

prime # = 127 $<$ 128

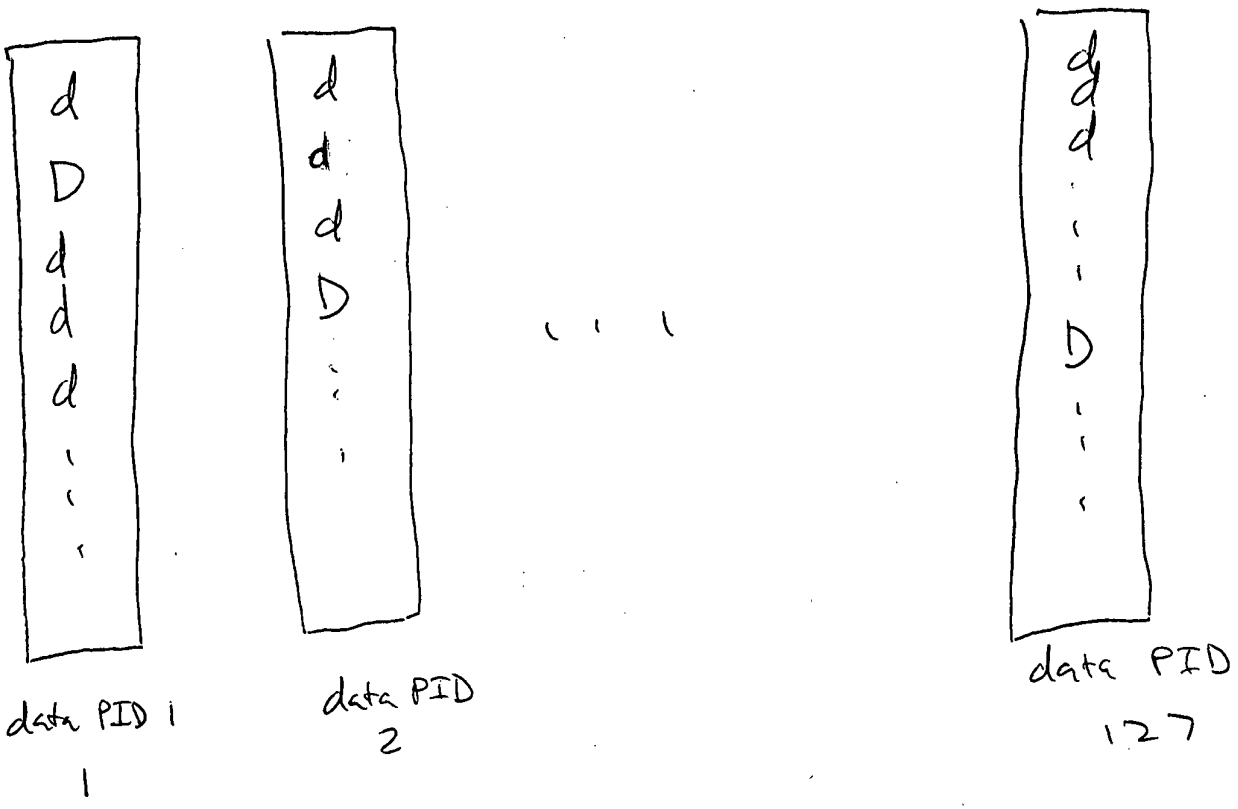
4424

data PID# = Video PID# (mod prime #)

= video PID# (mod 127)

4420

Fig. 44B



d= non-primetime data message

D= primetime data message

Fig. 44C